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INJURIES CAUSED BY ORTHODONTIC FORCES AND THE ULTIMATE RESULTS OF THESE INJURIES

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FOR the past several decades the orthodontist has accepted, almost as tradition, the biologic concepts of tooth movement. In considering the mechanical problems involved in a given corrective procedure, the physiologic effects and tissue changes resulting from tooth movement have been almost completely neglected. In recent years, however, there has been a growing interest in the tissue changes occurring with various degrees and types of orthodontic force.

In 1906 Sandsted, experimenting upon dogs, first reported tissue changes resulting from tooth movement. This work, however, has not only received slight attention but for the most part has been misinterpreted. Probably the first investigator who received recognition for studies of histologic changes occurring with the application of orthodontic force was Oppenheim. Since 1911 his work, performed on monkeys, has served as a criterion for clinical practice. Johnson, Appleton and Rittershofer, in 1926, reported the first studies in which measured forces were used. They worked on monkeys. Schwartz, in 1928, working with dogs, reported a series of studies in which teeth were moved by a known force active through a known distance. The first studies of this character in human beings were reported by Hershberger in 1932. Since that time numerous investigators have reported the histologic findings in human teeth which had been moved by orthodontic appliances before they were extracted. More recently Oppenheim has published an extensive report of the histologic findings in 15 human teeth which had been moved by various orthodontic forces. It is significant to note that in all of the human material

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reported upon, thus far, there were resorbed areas of the root surface, presumably produced by the injurious effects of the forces exerted by the appliances upon the teeth.

This report deals with the various injuries to the teeth and their supporting structures produced by orthodontic forces. The material to be presented has been selected from experimental studies upon 64 dogs and 14 human beings in which the teeth were moved by known forces active through measured distances.

Oppenheim has stated that it is impossible to move a tooth biologically. He has cited all the histologic work which has been reported on human material and has pointed out that in all of these cases there was evidence of root resorption. These resorptions constitute his evidence that there had been a pathologic process produced by the orthodontic force. Oppenheim has definitely indicated that there are many injuries produced by the orthodontist which will lessen the vitality and the longevity of the teeth.

It is unfortunate that the orthodontist cannot exert a force upon a tooth which is equal to the force which causes a tooth to erupt into its position. However, when one is faced with the task of correcting a case of malocclusion, one is in a position similar to that of an orthopedic surgeon who is faced with an orthopedic problem. The orthopedic surgeon does not hesitate to cut tendon and bone or to immobilize joints when these procedures are necessary to give a patient the best possible results both esthetically and functionally. An orthodontist, therefore, need not hesitate to correct a case of malocclusion for the purpose of giving the child a better masticatory mechanism, both esthetically and functionally, even though some slight injuries to the teeth and supporting tissues may result. The chief aim, however, is to move the teeth to their normal position for the case in question in the shortest time possible with a minimum of trauma.

Various injuries may be brought about in the teeth and supporting tissue as a result of trauma by orthodontic forces. The structures which may be affected are: (1) the peridental membrane; (2) the surface of the root; (3) the alveolar bone; (4) the gingiva; and (5) the pulp.

1. The injuries which may be produced in the peridental membrane by orthodontic forces are:

(a) A squeezing of the peridental membrane between the surface of the tooth and the alveolar bone which obliterates the flow of the blood in the vessels in the pressure area. This results in anoxemia of the tissue and, if the pressure is maintained long enough, necrosis results.

(b) Sudden heavy force may cause a tearing of the peridental membrane fibers on the side of tension. In cases in which the teeth are moved by a light auxiliary spring active through a greater distance than the width of the peridental membrane and in which the inclined planes of the opposing teeth interfere with the movement of the teeth, there may be intermittent tension and pressure on both sides of the teeth, thus producing a tearing and crushing of the peridental membrane fibers on both sides. This results in a loosening of the teeth due to the detachment of important groups of peridental membrane fibers.

2. The injuries occurring on the surface of the root are resorption of the cementum and the dentin. These resorptions apparently result from the squeezing of the peridental membrane between the tooth and the alveolar bone, thus causing an injury in the peridental membrane which is followed by a hyperemia in the areas above and below the injured, usually necrotic, peridental membrane. These hyperemic areas are manifested by undermining resorptions which remove the obstructing alveolar bone. At the same time that the alveolar bone is being resorbed, the surface of the tooth is also resorbed. These resorbed areas are present in an extremely high percentage of teeth which are moved orthodontically. It is safe to say that root resorption is produced in all cases of malocclusion which are corrected by orthodontic appliances. The position of the root resorption depends upon the type of movement and upon the character of the force applied. In a simple tipping movement by an auxiliary spring, the resorbed areas are at the alveolar crest on the pressure side, and on the opposite side of the apical surface of the root. Secondary resorptions may be produced on the root surface in the areas diametrically opposite to the primary resorption. The secondary resorptions are produced by the jiggling caused by the forces of the inclined planes during mastication. With more stable tipping appliances such as those in which the teeth are attached to stable arches by ligatures or bands, the arch does not permit so much jiggling and the secondary areas of resorption are not so frequently produced. The resorbed areas do not show up roentgenologically unless the resorption near the apex is extensive enough to reduce the length of the root. This occasionally happens when there is an extensive movement of the apex during the course of treatment.

With root moving appliances which move the apex more than tipping appliances, the major resorption is near the apex on the pressure side. This area is more liable to involve the apical end of the root and, therefore, will be seen by roentgenologic study.

3. The injuries to the alveolar bone during orthodontic treatment are: (a) reduction of the height of the alveolar crest; and (b) thinning out or complete elimination of the alveolar wall.

The alveolar crest is shortened by the rapid tipping of the teeth, the bone is not allowed to return to normal before the force is renewed. Thinning of the alveolar wall occurs in cases in which the tooth is moved bodily so rapidly during expansion that the alveolar bone on the buccal or labial surface is obliterated, thus leaving the buccal or labial surface covered by soft tissue only. The density of the alveolar bone depends to a certain degree upon the amount of functional stress placed upon it. Therefore, in rapid expansion, there is danger of extreme thinning or elimination of the labial or buccal wall by the removal of the functional stress by the force of the appliance.

4. Injuries to the gingiva during orthodontic treatment are produced by improperly fitting bands, by ligatures cutting into the gingiva, or by accessory attachments impinging on the gingiva. Food particles may lodge around parts of the appliance in positions in which it is in contact with the gingiva, producing irritation. All the injuries to the gingiva can be prevented

by properly designed and constructed appliances. The injury by food particles can be prevented by insisting that the patient cleanse the teeth thoroughly after every meal.

5. The injuries to the pulp that are produced during orthodontic treatment are the result of the shutting off of the blood supply or the production of hyperemia by the jiggling of the tooth during mastication, after the tooth has been loosened by the detachment of large areas of the peridental membrane fibers. This jiggling after the tooth has been loosened may result in a tearing or injury of the vessels entering the apical foramen. Another injury *may* be caused by the squeezing of the apex in the region of apical foramen against the bone, thus shutting off the blood supply to the pulp. There are relatively few pulps that become gangrenous during the course of orthodontic treatment. In most cases in which there is a degeneration of the pulp during orthodontic treatment there is a history of an accidental trauma which will account for the death of the pulp. Oppenheim shows degenerative lesions in the pulps of teeth which were treated orthodontically. He does not show control teeth to support these findings. Until control teeth are shown, the presence of degenerative lesions in the pulps of teeth which have been moved by orthodontic forces cannot be accepted as proof that the findings are due to the injurious effects of the orthodontic forces.

Fig. 1 shows the labial alveolar crest region of a maxillary second incisor of a young dog. The tooth was moved labially by an auxiliary spring which exerted a force of 120 gm. active through 2 mm. over a period of fourteen days. The peridental membrane has been squeezed between the tooth and the alveolar bone, thus obliterating its blood supply, which has resulted in asphyxia and necrosis. There is an undermining resorption taking place in the bone both apically and incisally to the necrotic area of the peridental membrane. The peridental membrane space is progressively wider apical to the necrotic area. The alveolar bone in the necrotic area is acting as a fulcrum to the tooth. There is an undermining resorption which is removing the alveolar crest in the area of the fulcrum. This process causes a shortening of the buccal alveolar bone. There is slight evidence of bone building on the labial surface of the bone. There is marked hyperemia both apically and incisally to the necrotic area.

The maxillary second incisor of a young dog which was moved labially by an auxiliary spring exerting a force of 120 gm. active through 2 mm. over a period of twenty-one days is shown in Fig. 2. The section shown here is from a similar area to that shown in Fig. 1; and the conditions of the experiment were the same except that the duration was twenty-one days instead of fourteen days. There is no evidence of necrosis or injury in the peridental membrane. There is a marked osteoblastic activity on both the peridental membrane surface and the labial surface of the alveolar bone. The alveolar bone is markedly thinner than is normal. The crest of the alveolar bone shows a marked bone growth which is re-establishing the original height of the alveolar crest. This section probably would have appeared the same as Fig. 1, had it been taken at the end of two instead of three weeks. In nature's attempt to relieve the obstruction and permit the tooth to move, there was over-

resorption of the alveolar bone. This osteoblastic activity is an effort to re-establish the normal width of the alveolar bone, which in turn was resorbed to permit the tooth to move buccally and demonstrates the inherent tendency of the peridental membrane to maintain a certain width.

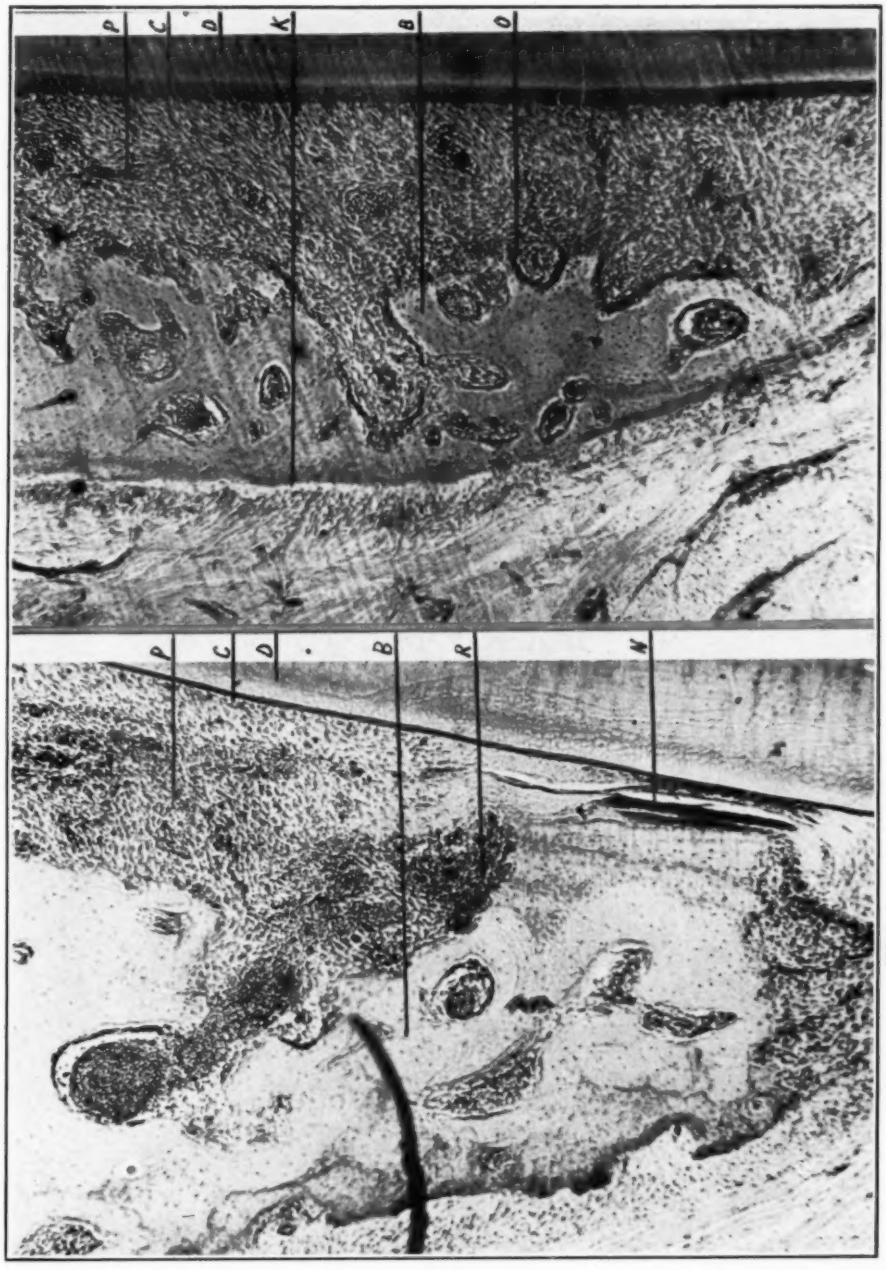

Fig. 1.

Fig. 2.

Fig. 1.—The labial alveolar crest region of the maxillary second incisor of a young dog. *D*, Dentin. *C*, Cementum. *P*, Peridental membrane. *N*, Necrotic peridental membrane. *R*, Undermining resorption. *B*, Bone.

Fig. 2.—Maxillary second incisor of a young dog, labial crest region. *D*, Dentin. *C*, Cementum. *P*, Peridental membrane. *O*, Osteoblast. *B*, Bone. *K*, New bone.

Fig. 3 shows the buccal alveolar crest region of a maxillary first bicuspid of a child thirteen years old. The appliance consisted of an 18 gauge lingual arch with a 24 gauge auxiliary spring. The spring exerted a force of 100 gm. active through 1.5 mm. The tooth was moved 0.8 mm. buccally in twenty-nine days. There was 12 gm. active through 0.6 mm. at the termination of the

experiment. This section shows the tooth pressed against the alveolar bone which has caused necrosis of the peridental membrane in the crest area. There is an undermining resorption taking place both apically and occlusally to the necrotic area of the peridental membrane. At the tip of the crest the under-

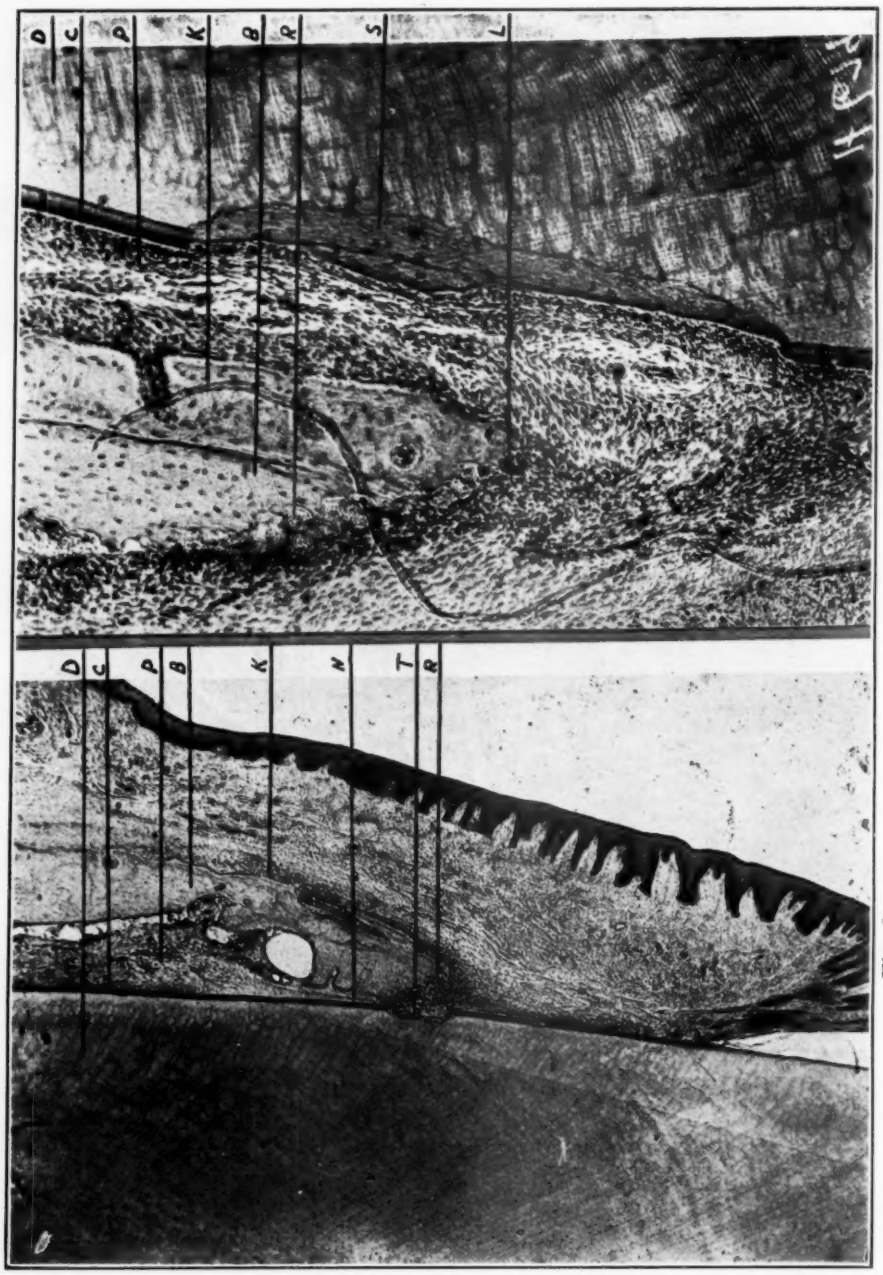

Fig. 3.

Fig. 3.—The buccal alveolar crest region of a maxillary first bicuspid of a child thirteen years old. *D*, Dentin. *C*, Cementum. *P*, Peridental membrane. *N*, Necrotic peridental membrane. *T*, Tooth resorption. *R*, Undermining resorption. *B*, Old bone. *K*, New bone.

Fig. 4.—The buccal alveolar region of a maxillary bicuspid of a child thirteen years old. *D*, Dentin. *C*, Cementum. *P*, Peridental membrane. *S*, Secondary cementum repair. *K*, New bone. *B*, Old bone. *R*, Bone resorption. *L*, Osteoclast.

Fig. 4.

mining resorption is resorbing both the bone and the surface of the root. Occlusally to this area there is a small resorption which just passes through the cementum, this probably indicates the original height of the alveolar crest. There is a slight amount of new bone formation on the buccal surface of the alveolar process.

Fig. 4 shows the buccal alveolar region of a maxillary first bicuspid of a child thirteen years old. The appliance consisted of an 18 gauge lingual arch with a 24 gauge auxiliary spring attached to the tooth by a stainless steel ligature. The spring exerted a force of 100 gm. active through 2.5 mm. in a

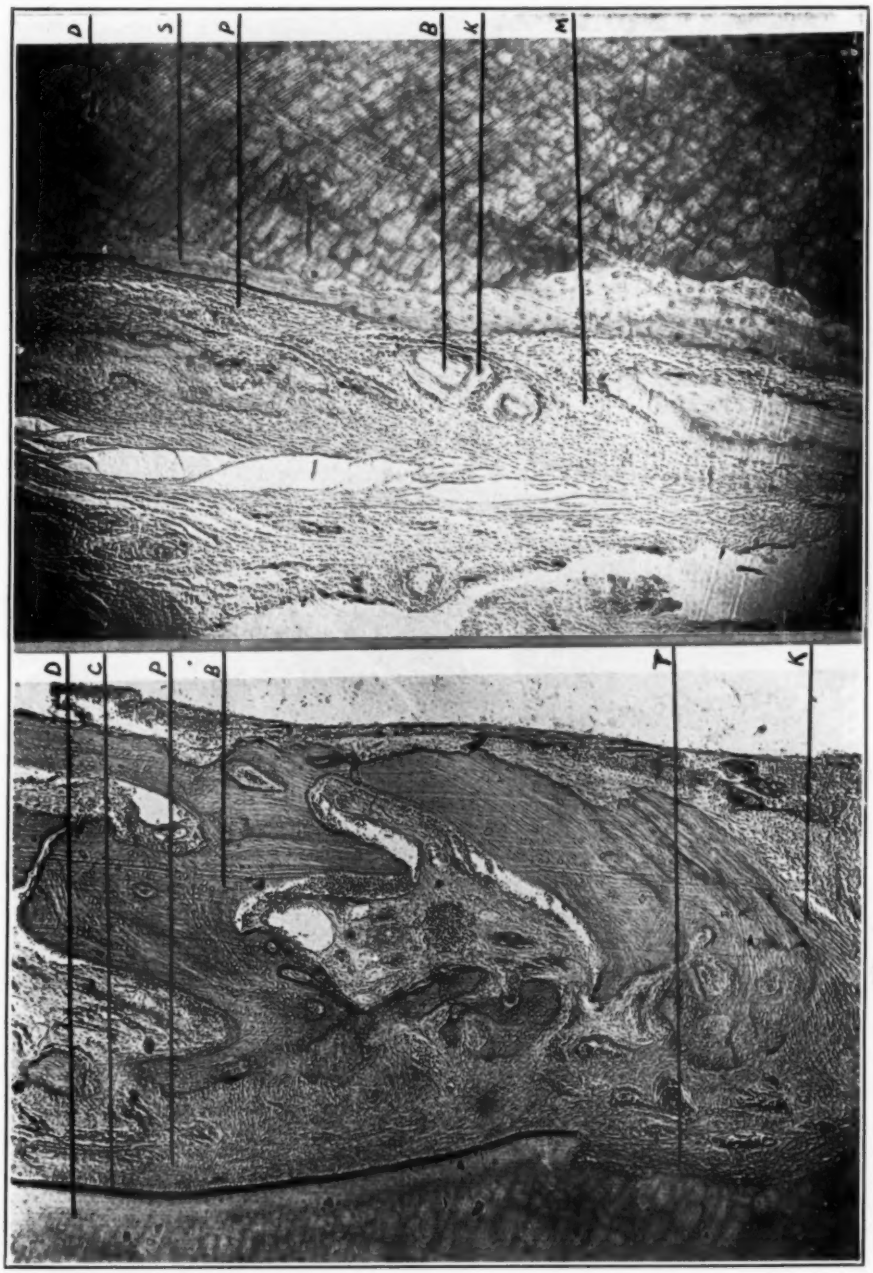

Fig. 6.

Fig. 5.—The maxillary first bicuspid of a child fourteen years old. *D*, Dentin. *C*, Cementum. *P*, Peridental membrane. *T*, Tooth resorption. *B*, Bone. *K*, New bone.

Fig. 6.—The buccal alveolar crest region of a mandibular first bicuspid of a child fourteen years old. *D*, Dentin. *S*, Secondary cementum. *P*, Peridental membrane. *B*, Old bone. *K*, New bone. *M*, Perforation of alveolar process.

lingual direction. The tooth moved 1 mm. lingually in twenty-nine days. There was 5 gm. active through 0.2 mm. at the termination of the experiment. This section shows a large resorption area of the surface of the root which is penetrating the dentin and has been repaired by secondary cementum formation. The peridental membrane appears normal. The alveolar crest appears

markedly shorter, as its highest point is much below the highest point of the resorption area in the surface of the root. The new bone formation is not in long spicules. There is resorption of the buccal surface of the alveolar bone. The resorbed area in the surface of the root is undoubtedly produced by the jiggling of the tooth caused by occlusal interference during mastication.

Fig. 5 shows the maxillary first bicuspid of a child fourteen years old. The appliance consisted of an 18 gauge lingual arch with a 30 gauge auxiliary spring. The spring exerted a force of 5 gm. active through 1.5 mm. in a buccal direction. The tooth moved 0.8 mm. in fifty-one days. There were 2 gm. active through 0.5 mm. at the termination of the experiment. This section shows the buccal alveolar crest region. It shows a large resorbed area on the surface of the root in which there is no repair taking place. The peridental membrane is apparently thinner than normal. There is resorption taking place on the peridental membrane side of the alveolar process. There is slight evidence of new bone building on the buccal surface of the alveolar process. This section demonstrates that even a light force may produce root resorption when there are other forces interfering with the action of the orthodontic forces. This tooth occluded with the mandibular teeth.

Fig. 6 shows the buccal alveolar crest region of a mandibular first bicuspid of a child fourteen years old. The appliance consisted of an 18 gauge lingual arch with a 27 gauge auxiliary spring. This spring exerted a force of 16 gm. active through 2 mm. in a buccal direction. The tooth moved 0.8 mm. in fifty-one days. There was 4 gm. active through 0.2 mm. at the termination of the experiment. This section shows marked resorption of the surface of the root which has been repaired by secondary cementum formation. The peridental membrane space is extremely narrow. There is a thinning of the buccal alveolar process, and there are numerous perforations in the process. There is resorption taking place on the peridental membrane surface of the bone, and new bone building is taking place on the buccal surface of the process. This section demonstrates that the tooth has been moved bodily due to the counteraction of the orthodontic force by occlusal forces. This section also demonstrates that light forces may produce root resorptions when they are interfered with by other forces.

Fig. 7 shows the maxillary first bicuspid of a child thirteen years old. The appliance consisted of an 18 gauge lingual arch with a 24 gauge auxiliary spring. This spring exerted 100 gm. of force active through 2.4 mm. over a period of twenty-nine days. The tooth was moved buccally. There were 8 gm. active through 0.2 mm. at the termination of the experiment. This section is of the lingual alveolar crest region. The peridental membrane appears normal. There is no injury to the surface of the root. There is new bone formation on the peridental membrane surface of the process with the spicules arranged perpendicular to the surface of the root. The new bone formation is thicker at the crest than farther apically, indicating that the tooth was tipped buccally. There was an elongation of the crest further indicating that the tooth was tipped.

Fig. 8 shows the buccal alveolar crest region of the same tooth as shown in Fig. 7. There is no injury to the surface of the root in this section. The

peridental membrane space appears about normal in width. There is a marked osteoclastic activity on the peridental membrane surface of the alveolar process which indicates that the tooth was still moving buccally. This tooth did not

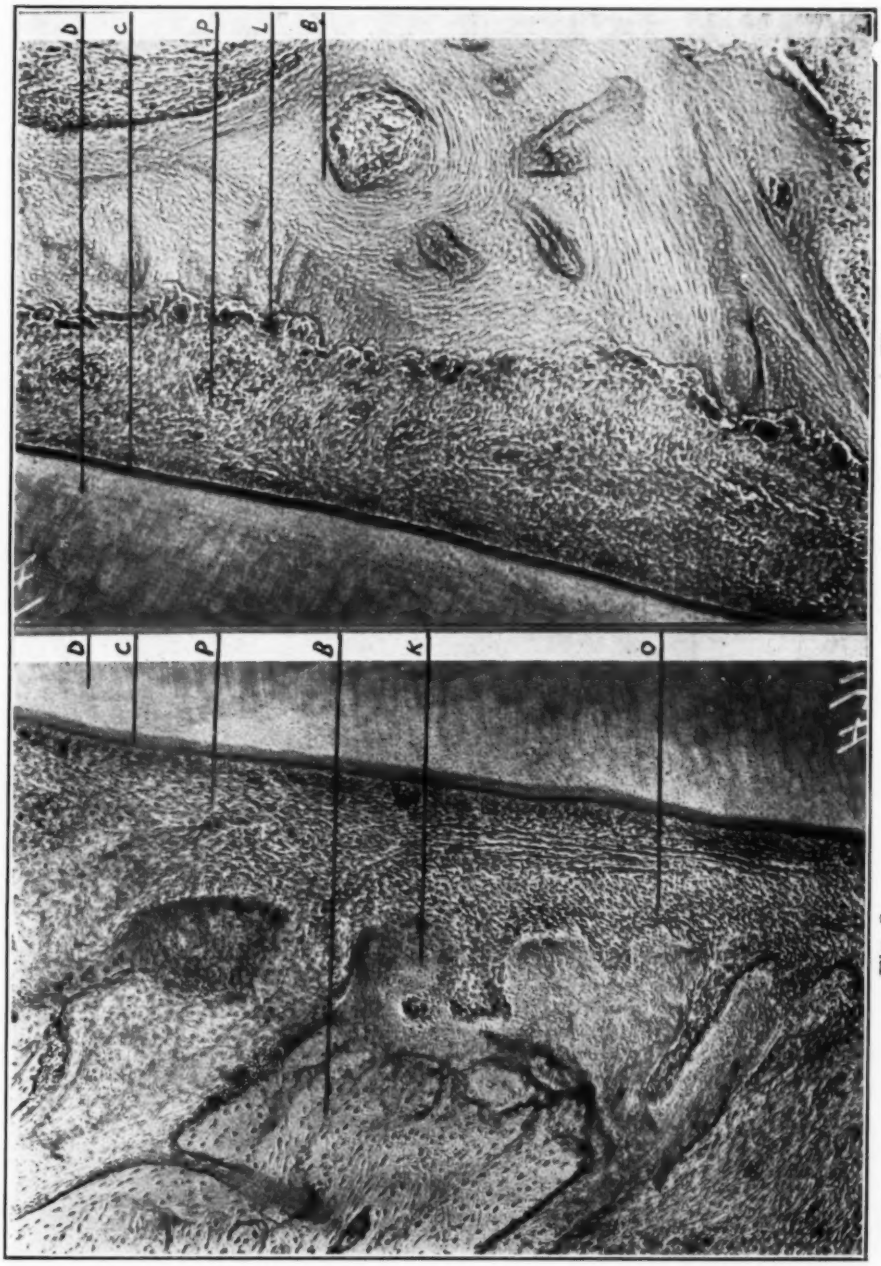

Fig. 7.

Fig. 8.

Fig. 7.—The maxillary first bicuspid of a child thirteen years old, lingual arch. *D*, Dentin. *C*, Cementum. *P*, Peridental membrane. *O*, Osteoblast. *K*, New bone. *B*, Old bone.

Fig. 8.—The buccal alveolar crest region of the same tooth as shown in Fig. 7. *D*, Dentin. *C*, Cementum. *P*, Peridental membrane. *L*, Osteoclast. *B*, Old bone.

occlude with any teeth in the mandibular arch; thus there was no interference with the orthodontic force, and there was no resorption in the surface, indicating that the tooth had been moved biologically.

Fig. 9 shows the maxillary first bicuspid of a child fourteen years old. The appliance consisted of a 19 gauge labial arch. The tooth was ligated to the arch with a steel ligature which exerted a force of 120 to 150 gm. active

through 0.2 to 0.3 mm. The force was re-activated six times at fourteen-day intervals. The tooth was extracted twenty-eight days after the last adjustment. The tooth was moved 1.1 mm. in eighty-two days. The tooth occluded with the mandibular bicuspids, and the occlusal interference caused it to move

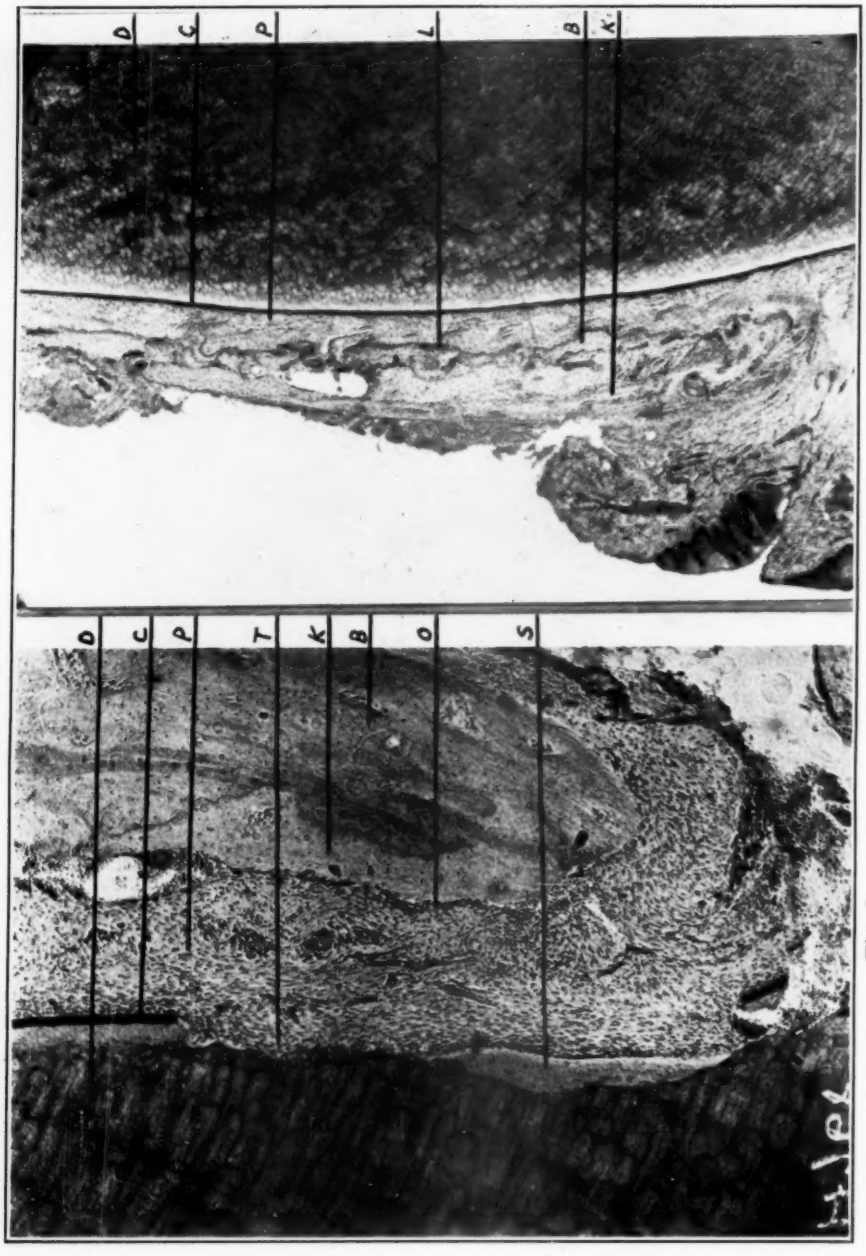

Fig. 9.

Fig. 10.

Fig. 9.—Maxillary first bicuspid of a child fourteen years old. *D*, Dentin. *C*, Cementum. *T*, Tooth resorption. *S*, Secondary cementum. *P*, Peridental membrane. *K*, New bone. *B*, Old bone. *O*, Osteoblast.

Fig. 10.—Maxillary first bicuspid of a child fourteen years old. *D*, Dentin. *C*, Cementum. *P*, Peridental membrane. *L*, Osteoclast. *B*, Old bone. *K*, New bone.

bodily. This section shows the buccal crest. There is a marked resorbed area of the surface of the root which has begun to repair by secondary cementum formation. The peridental membrane fibers are not arranged in distinct groups. There is new bone formation on the buccal surface of the process. There is new bone formation on the tooth side of the process, indicating that there was no force being exerted by the appliance, at the time of re-

moval; and that the peridental membrane space was being adjusted to its normal width. There were resorbed areas on both the buccal and the lingual roots in the pressure areas of the peridental membrane near the apices.

Fig. 10 shows the maxillary first bicuspid of a child fourteen years old. The appliance consisted of a 19 gauge labial arch. The tooth was ligated to the

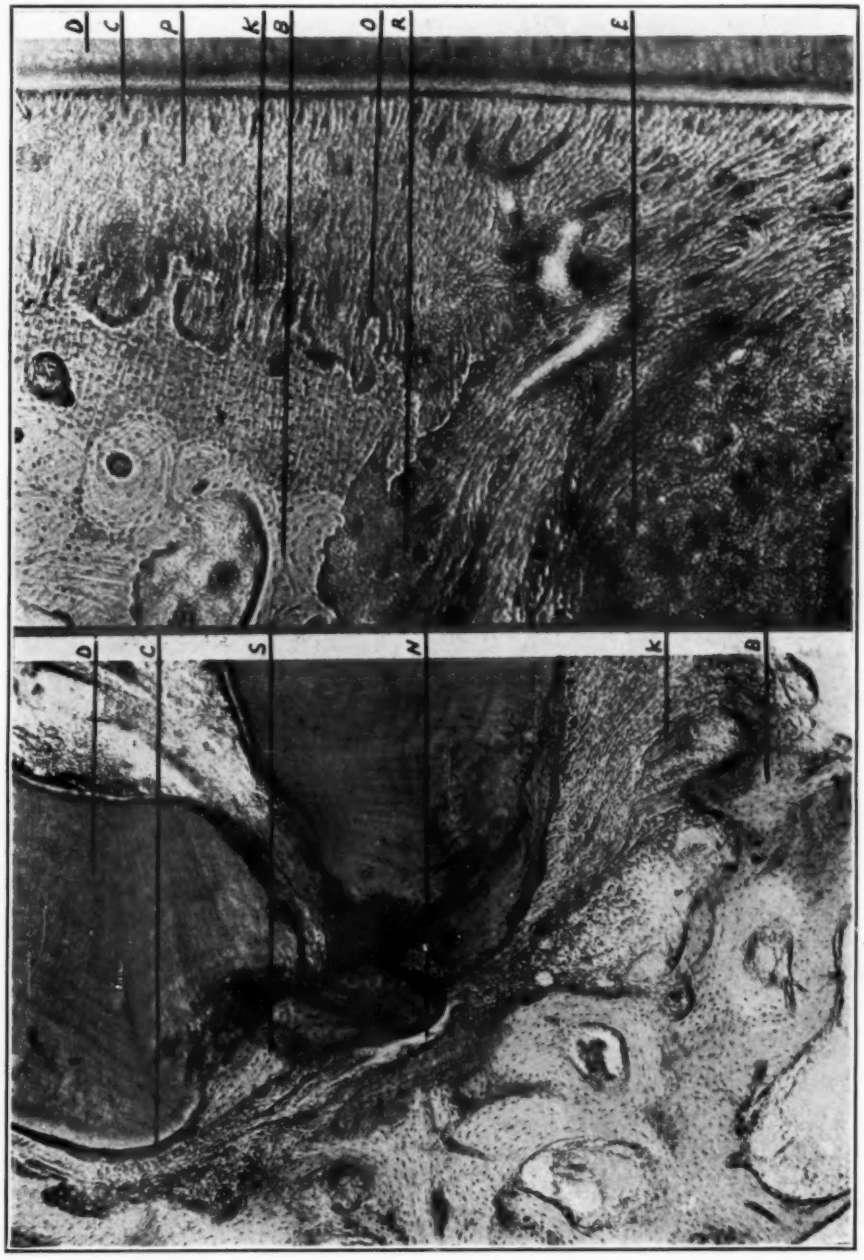

Fig. 11.

Fig. 12.

Fig. 11.—The apical region of a third premolar of a young dog. *D*, Dentin. *C*, Cementum. *S*, Second cementum. *N*, Necrotic peridental membrane. *B*, Old bone. *K*, New bone.

Fig. 12.—The lingual alveolar crest region of a maxillary second incisor of a young dog. *D*, Dentin. *C*, Cementum. *P*, Peridental membrane. *O*, Osteoblast. *R*, Bone resorption. *B*, Old bone. *E*, Round cell infiltration.

arch with a steel ligature, exerting a force of 150 to 200 gm. active through 0.15 to 0.2 mm. The force was re-activated six times at fourteen-day intervals. The tooth was removed fourteen days after the last adjustment. The tooth occluded with the mandibular bicuspids; therefore the force of the appliance was counteracted by the forces of the inclined plane during mastication. This

caused the tooth to move bodily. This section shows the buccal alveolar crest region. The peridental membrane is thin, and there is an osteoclastic activity on the peridental membrane side of the alveolar bone. There is new bone formation taking place on the buccal surface of the alveolar bone. The bone in the bifurcation of the roots indicated that the tooth had moved bodily. Since there was no resorbed area on the surface of the root, it can be assumed that this tooth moved biologically.

Fig. 11 shows the apical region of a third premolar of a young dog. The appliance consisted of an 18 gauge lingual arch with a 24 gauge auxiliary spring. The spring exerted a force of 120 gm. active through 2 mm. over a period of fourteen days. The spring slipped up on the cingulum which caused pressing of the tooth into the alveolus at the same time it was moved buccally. This section shows a necrotic area in the peridental membrane in the region of an apical foramen. We see from this that, if such a situation should be produced in the human tooth, it is possible that the pulp would be strangulated, thus producing degeneration of the pulp. Human teeth usually have only one apical foramen while the dog has several.

Fig. 12 shows the lingual alveolar crest region of a maxillary second incisor of a young dog. The tooth was moved labially by a labial arch, the tooth being ligated to the arch. This section shows the injury of the gingiva which has been produced by the ligature cutting into the tissue. There is a marked round cell infiltration in the area of the injured tissue. The crest of the alveolar bone is being resorbed because of the inflammation produced by the irritation of the ligature.

There was no soreness or loosening of any of the human teeth shown, and from clinical findings we would expect to find the minimum of damage.

DISCUSSION

This material demonstrates that the much feared injuries which are caused by the orthodontic appliances are more theoretical than real. It is observed that a necrotic area of the peridental membrane undergoes repair; that a resorbed area of the tooth will be repaired by secondary cementum. It is well known that an irritated gum will heal. All these phenomena are the normal reaction to injury.

The bounds of safety, however, can be overstepped; to prevent this, orthodontic knowledge and judgment must be used. The successful orthodontist has learned by intelligent observation that there are certain clinical signs which indicate when he is about to overstep the healing tolerance of nature. It has been clearly shown that better results can be obtained by analyzing the forces which are used and giving the supporting tissues sufficient time to react to those forces, before an appliance is readjusted. It is evident from the data presented that the rapid movement of teeth with auxiliary springs which are active through a distance greater than the width of the peridental membrane, and where the tooth is in occlusion, causes multiple root resorptions.

These findings are in accord with the observations of Oppenheim. Resorptions will repair, provided sufficient time elapses between adjustments, and

the supporting tissues are allowed to return to normal. The same movements can be produced by more rigid appliances with fewer resorptions.

The data presented further demonstrate that the distance through which the force is active, and not the amount of orthodontic force used, is the important factor. The time elapsing between adjustments is also important. The forces which act on the tooth due to the interference of the inclined planes during mastication are responsible for most of the extensive injuries.

There is an individual difference in patients; some will progress much more rapidly than others; with orthodontic experience and judgment one is able to detect these differences.

Root resorption occurred in all cases in which the force was active through a greater distance than the width of the peridental membrane, and the tooth occluded with the teeth in the opposing arch. This occurred even though the force was as light as 5 gm. Schwartz states in his formula of degrees of biologic effect of force that a force of 20 gm. per square centimeter of root surface will produce biologic tooth movement. He proves this statement by moving the premolars of dogs and showing that forces of 20 gm. or less produce a biologic tooth movement. Since the premolar teeth of dogs do not occlude when the jaws are closed and since the dog's mandible does not have the same movements as that of the human, this material cannot be used to interpret human clinical material. In Figs. 7 and 8 there was 100 gm. force used, and the tooth moved biologically. However, it did not occlude with teeth in the mandibular arch; while in Fig. 5 the tooth was moved with a force of *only* 5 gm. and there was root resorption. This tooth occluded with teeth in the opposing arch. In Fig. 10 the tooth was moved with a force of 150 to 200 gm. active through 0.15 to 0.2 mm. The tooth moved biologically. This tooth was in occlusion. In Fig. 9 the tooth was moved with a force of 120 to 150 gm. active through 0.2 to 0.3 mm. There was root resorption in this tooth. It occluded with the teeth in the mandibular arch. These four cases demonstrate that it is not the amount of orthodontic force that produces the root resorption but the distance through which the force is active. The interfering forces of the inclined planes cause injuries. One could apply a ton of force and, as long as the force was not active through great enough distance to obliterate the blood vessels of the peridental membrane in any area, the tooth would probably move without root resorption.

If one could apply a force which would be light enough to prevent the formation of anoxemic areas in the peridental membrane, it would probably be possible to move the teeth without resorption, even though the force was active through a distance greater than the width of the peridental membrane space.

Alexander Klein measured the peridental membrane space of a large number of teeth. He found the average width to be 0.23 mm. The alveolus has the shape of an hourglass. The peridental membrane space is widest at the crest and narrowest near the middle, then wider again in the apical region. We must keep the heavy force active through less than 0.2 mm. when the teeth are in occlusion if we are to avoid injuries to the teeth and supporting tissues.

Cases have been reported in which progressive, idiopathic root resorptions occurred without orthodontic interference. This fact is falsely used as an excuse for apical resorptions in orthodontic cases.

CONCLUSIONS

1. Root resorption occurs in practically all cases of malocclusion that are treated orthodontically.

2. Necrotic areas are produced in the peridental membrane of a large percentage of cases of malocclusion that are treated orthodontically.

3. The necrotic peridental membrane and the resorbed areas of the root will repair, provided the force is not re-activated too often.

4. It is possible to move a tooth buccally or labially so rapidly that the buccal or labial process will be obliterated.

5. Auxiliary springs permit jiggling of the teeth that are in occlusion, thus producing numerous root resorptions.

6. Fixed appliances do not permit as much jiggling; therefore there is less root resorption produced by fixed appliances.

7. There are relatively few pulps killed by orthodontic forces.

8. The injuries to the gingiva can be reduced by properly fitting appliances.

9. There should be enough time elapse between adjustments to allow all the supporting tissues to return to normal.

10. The forces of the inclined planes during mastication are important factors in the injuries to the surface of the tooth and to the peridental membrane.

11. The important factors in the injuries caused by orthodontic force are: (a) the amount and type of force; (b) the distance through which the force is active; (c) the forces other than those exerted by the appliance.

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DISCUSSION

Dr. Harry E. Kelsey.—I want to call attention to a book which was published a great many years ago by Dr. Farrar, in New York, in which he stressed the importance of intermittent pressure as compared with continuous pressure. It is interesting to note that Dr. Stuteville has called attention to the fact that an intermittent force operates less harmfully upon the tooth than does a continuous force. I think those men—perhaps Dr. Mershon who introduced the lingual arch and the light springs with it—have also stressed the fact that frequent changes so far from being better were far worse than with long periods between the changing of the stress of the spring.

I was also very much impressed with the fact that Dr. Stuteville called attention to that form of occlusion which we hear so much about from the periodontist, the traumatic occlusion. It is undoubtedly true that we do produce traumatic occlusion in many of the orthodontic movements which we bring about.

Dr. Horace L. Howe.—I should like to ask for my own information how the essayist obtained those beautiful specimens from the human individual, and were the teeth sacrificed or how were they obtained?

Dr. Stuteville.—I shall not try to defend the practice of sacrificing teeth. I realize that the criticism is justified. However, after extensive study of the patients presented for orthodontic treatment at the clinic, we were able to collect several cases in which it was deemed advisable for various reasons to sacrifice teeth. The appliances were constructed and applied in the manner that has been described. Then, after a given time, the teeth were extracted surgically. In the extraction, the buccal alveolar plate was taken out with the tooth. The extraction was carried out by making cuts parallel with the long axis of the tooth in the interproximal spaces on the buccal surface. These cuts were carried apically to a few millimeters below the crest of the bone. Then, there was a horizontal incision made connecting these two incisions. These cuts left the gingiva attached to the tooth and the crest of the bone. The horizontal incision was carried distally about one or two centimeters. Then, a vertical incision was made from the termination of this horizontal incision apically to the reflection of the mucous membrane. The mucous membrane was then stripped from the buccal alveolar bone by means of a periosteotome. Then a small Fischer bur was used to make cuts in the buccal alveolar bone medial and distal to the tooth (being careful not to injure the surfaces of the roots of the approximating teeth), the cuts extending from the crest of the bone to the apex of the tooth. Then a horizontal cut was made connecting these two cuts. After the buccal alveolar bone was freed so that it was only attached to the tooth by means of the periodontal membrane, the tooth was extracted by exerting force in a buccal direction by either forceps or elevators. After the tooth was removed, the mucous membrane was sutured back to position, and the socket was allowed to heal as in a surgical extraction. The final results of the extraction are no different from those of an ordinary forceps extraction. The tissue was carried through the usual histologic procedures.

Dr. John V. Mershon.—I should like to ask what does the essayist mean by biologic tooth movement?

Dr. Stuteville.—I take the term "biologic tooth movement" from Oppenheim's interpretation, in which he interprets that there has been a biologic tooth movement if there are no resorbed areas on the surface of the tooth; in other words, if there is no evidence at the time the tooth is extracted that there has been a pathologic lesion produced in the periodontal membrane, we take it as a biologic tooth movement; although I will grant that any movement we produce can be interpreted as a pathologic tooth movement. Even where there is no bone resorption, if you get right down to it, you can say it is a pathologic process, but taking the interpretation of Oppenheim, a biologic tooth movement is one in which there is no root resorption.

Dr. B. Edwin Erikson.—I should like to ask Dr. Stuteville if he means to imply from his findings that functional exercise in tooth movement is detrimental.

Dr. Stuteville.—I was expecting that question. I would say that functional movement or exercise such as some men employ by using the orthodontic dumbbell or having the patient chew soft unvulcanized rubber is not detrimental provided sufficient time elapses between adjustments to give the supporting tissues sufficient time to return to normal. As had been shown clinically for many years by Dr. Mershon, an appliance which primarily exerts a tipping force will move the teeth bodily, provided there is sufficient time elapse between adjustments to allow the action of the inclined planes to move the apex along with the crown. Several of the specimens which I showed confirm these clinical findings.

Dr. Norris C. Leonard.—I should like to ask Dr. Stuteville about the necrotic areas produced in the periodontal membrane. He spoke of producing necrotic areas by a too rapid movement. Does he mean actual death of the cells, or is it just an interference with the normal function?

Dr. Stuteville.—Would you like to see a slide illustrating that?

Dr. Leonard.—No, I will not take the time of the meeting to do that.

Dr. Stuteville.—By necrotic areas I mean actual death of tissue. Where the tissue becomes absolutely necrotic, there is no way of reviving it. Where the tooth is locked against the bone, shutting off the blood supply, the periodontal membrane in that area becomes necrotic; that is, there is a death of the cells. Two of these sections show that necrotic area which I pointed out to you. You probably could not see it from the lantern slide, although in the histologic slide there is an area very definitely of a cellular destruction in the periodontal membrane.

Dr. Leonard.—Does that necrotic periodontal membrane regenerate?

Dr. Stuteville.—Yes, it does regenerate. The unfortunate thing is that there is very little known about the periodontal membrane. Some one in Europe did some work showing that the periodontal membrane was made up of white fibrous connective tissue and showed that there was no elasticity to the fibers. Therefore, when a tooth is moved, there must be some change in the periodontal membrane fibers. My idea of this is that there is one group of fibers attached to the bone and another group attached to the cementum, and there is an interlocking of those two groups. The first thing that is noticed in a repair of an injury to the periodontal membrane is that the space is filled with connective tissue in which the fibers are arranged more or less parallel with the surface of the root, rather than perpendicular in groups of fibers. As time goes on, the fibers gradually arrange themselves in a normal position. When there is resorption of the surface of the root and also of the alveolar bone, as is found in the necrosis of the periodontal membrane, the repair is marked by secondary cementum formation on the surface of the root and new bone formation on the surface of the alveolar bone. As function demands it, the new connective tissue in the space between the bone and the tooth is arranged as a normal periodontal membrane.

Dr. John V. Mershon.—We have terms springing up in the profession which seem to be rather an apt method of expressing certain things by certain men, and to them such terms seem to have quite a definite meaning. We have in very recent years had a term that has been injected into orthodontia that I have tried a good many times to find out just what they were undertaking to convey by it, and that is that term "jiggling," "tooth jiggling."

Dr. Stuteville.—That term was originated by Dr. Oppenheim, as I remember it. He was the first one to use it, and his interpretation is what I had in mind.

Dr. Mershon.—Well, what is his interpretation of the definition of jiggling?

Dr. Stuteville.—Jiggling as interpreted by Dr. Oppenheim is this (demonstrating with pointer): the tooth has a certain position in the alveolus. This position is determined by the balance of forces in the periodontal membrane. When an outside force is exerted on the tooth—say from the lingual—the tooth moves in the direction of the force until it is again in balance (indicating). Then, with the tooth in balance in the new position, the patient bites down and the force of the inclined planes moves the tooth back (indicating) to the original position or beyond it. The instant the force of the inclined planes is removed, the outside force again moves the tooth back to where it is in a balance of forces (indicating). Dr. Oppenheim interpreted that as jiggling.

Dr. Mershon.—Do you look upon that as an actual picture of what happens?

Dr. Stuteville.—Do I think that that actually happens?

Dr. Mershon.—Yes.

Dr. Stuteville.—I think it happens with every appliance.

Dr. Mershon.—And with every tooth, whether there is an appliance on it or not?

Dr. Stuteville.—Yes, but here is the difficulty. The tooth is moved buccally (indicating) and if the force is heavy enough, the tooth squeezes the periodontal membrane between the surface of the root and the alveolar bone, causing a necrotic area in the periodontal membrane, thus destroying the horizontal group of fibers (indicating). Then, when the patient bites, the force of the inclined plane moves the tooth back lingually (indicating), there being no horizontal group of periodontal membrane fibers to resist the lingual movement of the tooth. It continues to move until it is locked against the lingual alveolar crest, thus causing necrosis of the periodontal membrane on the lingual side of the tooth (indicating). Then, since the horizontal groups of periodontal membrane fibers are destroyed on both the buccal and the lingual side, there is nothing to prevent the tooth from coming in contact with the crest of the alveolar bone each time there is a movement back and forth. The final result of this is resorption of the surface of the root on both the buccal and the lingual sides.

Dr. Mershon.—I have had Dr. Oppenheim explain that same thing to me, and all I have to say is, thank God that Oppenheim does not put any auxiliary springs on any of my patients.

Dr. Harry E. Kelsey.—You speak of necrotic areas being regenerated. Is that possible? Do you mean they are absorbed and new tissue forms? It has always been my understanding that when there is necrotic tissue, it is dead tissue, and no regeneration is possible.

Dr. Stuteville.—I did not mean that there was a regeneration of the dead tissue. The necrotic area in the periodontal membrane is a sterile area, and it will be repaired by connective tissue. There is a gradual resorption of the necrotic tissue. At the same time there is an infiltration of new fibral blasts and the formation of new fibrous tissue.

Dr. Kelsey.—You mean that the necrotic tissue is absorbed and new tissue is built, but it is not a regeneration of necrotic tissue.

Dr. Stuteville.—No, I probably misinterpreted the question. I meant the area repaired by new tissue, new fibrous tissue, not the revivification of the dead tissue.

DEEP BITES IN ADULTS

Illustrating the Value of Orthodontic Treatment Preliminary to Prosthetic Restorations

Abraham Wolfson, D.D.S., Newark, N. J.

DEEP overbites have been treated by orthodontists as well as prosthodontists for a good many years with varying results. I hope I am not too presumptuous in saying that orthodontists have treated these cases much more successfully than have prosthodontists.

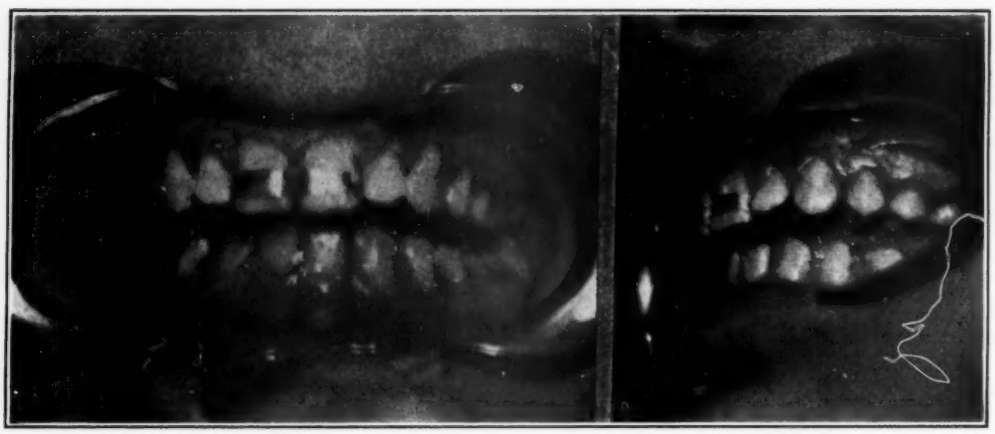

Fig. 1. Fig. 2.

Fig. 1.—Anterior view of jaw relations upon insertion of a typical anterior splint.
Fig. 2.—Lateral view showing extent of opening in the posterior region.

In my own approach to this problem, I have made a careful study of the literature, mostly orthodontic, and find that while much has been written on treatment, very little work has been done in the matter of diagnosis.

For a long time, and even now, some orthodontists have made the assumption that deep overbites are the result of a lack of vertical development in the premolar and molar regions. Once such an assumption is made, there is no further need for investigation. Others, however, felt that such assumptions would not be warranted without genuine scientific evidence. The result of this attitude has been that various measurements were undertaken. Techniques of measurement have fallen into two categories: the simple but inaccurate, and the accurate but complicated. One of the difficulties which presents itself in the handling of orthodontic material is the factor of growth, for which due allowance must be made.

Read before the New York Society of Orthodontists, March 16, 1937.

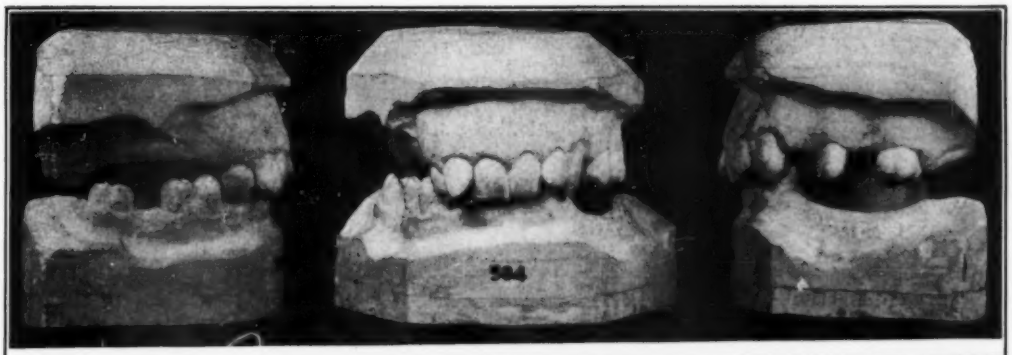

Fig. 3.

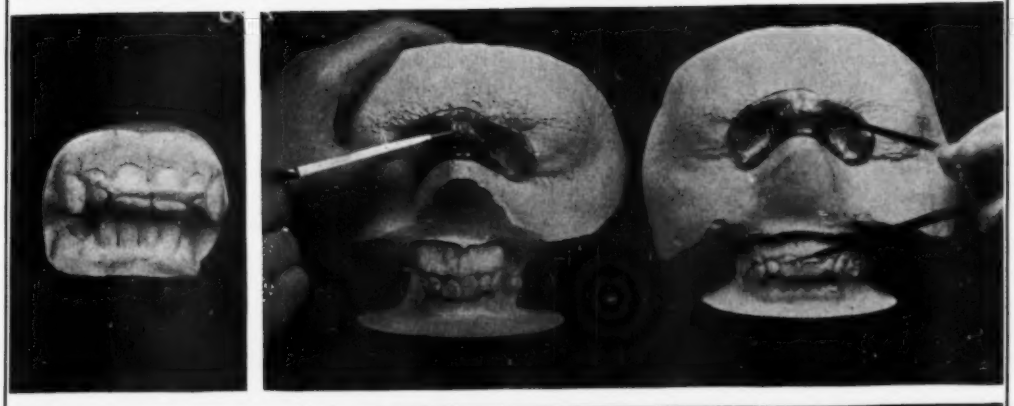

Fig. 4.

Fig. 5.

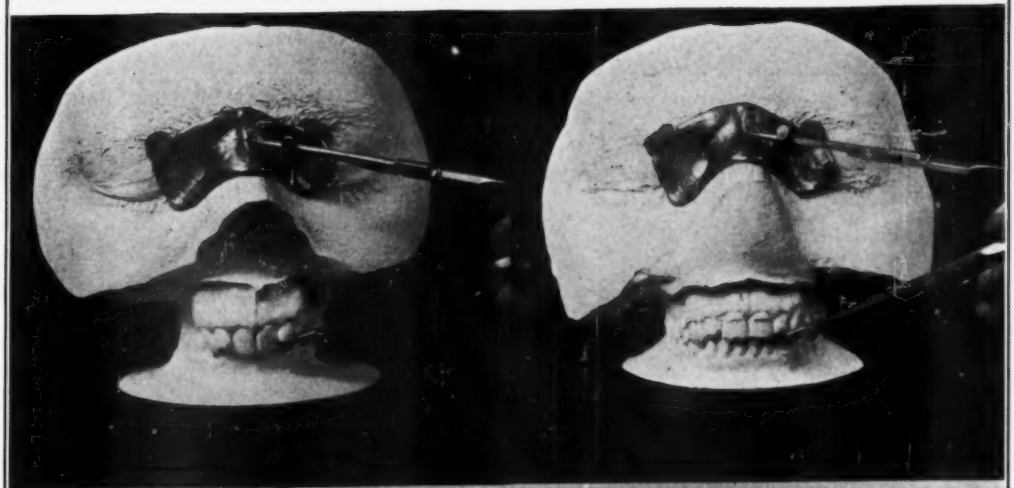

Fig. 6.

Fig. 7.

Fig. 3.—First case. Excessive overbite.

Fig. 4.—Anterior splint in position.

Fig. 5.—Dentofacial casts showing change of maxillary anterior teeth in the vertical plane. Calipers measure from fixed point on the bridge of the nose to gingival border of maxillary central incisors. Same caliper, unchanged, is applied to cast of finished case.

Fig. 6.—Same technique for showing change in mandibular anterior teeth.

Fig. 7.—Case completed and restorations in place.

For some time I have felt the need for an adequate approach to this problem, both as it concerns the orthodontist in his daily work, and also as it concerns the prosthodontist in his problems of restorations and balanced bites. An adequate investigation of this problem would have to be practical, simple and accurate. To eliminate the factor of growth, I undertook to make careful observations upon adults. It was necessary to begin without making any assumptions, and to proceed without the implications of assumptions.

TECHNIQUE EMPLOYED

In adult cases presenting a deep overbite, I constructed and inserted at the beginning of treatment, wherever possible, an anterior incisal splint (Figs. 1 and 2), attached firmly to the maxillary central incisors in most cases, and

Fig. 8.

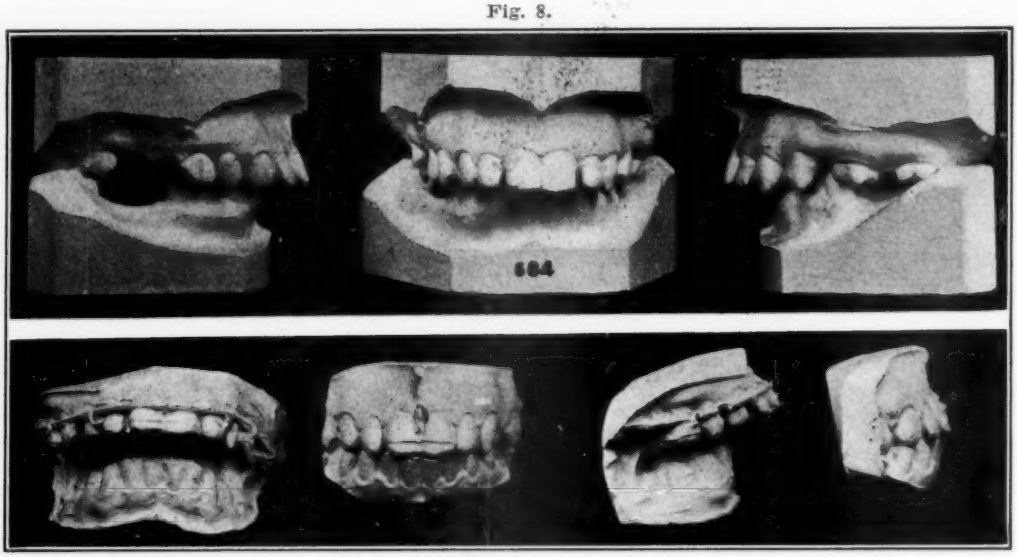

Fig. 9.

Fig. 8.—Right side shows excessive over-jet in the anterior region and several missing teeth in the posterior region. Anterior view shows excessive overbite. Left side further illustrates the depth of overbite and all teeth missing in the mandibular posterior to second premolar.

Fig. 9.—Showing splint in position at beginning of treatment, and change produced near completion of treatment.

where indicated, involving four or six of the maxillary anterior teeth. At the same time I instituted routine orthodontic treatment for the rest of the malocclusion. Case records were made both at the beginning and at the end of treatment. These consisted, in addition to the routine casts and radiographs, of a dentofacial cast, in which the relation of the teeth to a fixed portion of the face could be accurately registered.

CASES TREATED

The first case (Figs. 3 to 7) is that of a dentist, aged thirty-six years, presenting a very deep overbite, protruding maxillary lateral incisors, all teeth posterior to the maxillary canine on the right side missing, and all the mandibular teeth posterior to the left cuspid missing. Several attempts had been made in this case to build up in the posterior region.

The second case (Figs. 8 and 9), which is still under treatment, presents a female, aged twenty-eight years, with a Class II Division 1 malocclusion, mandibular anterior teeth striking the palate, mandibular arch excessively contracted, and many missing posterior teeth.

The third case (Figs. 10 to 14), a female, aged thirty-five years, presented with the following history. Many years before, she had orthodontic treatment

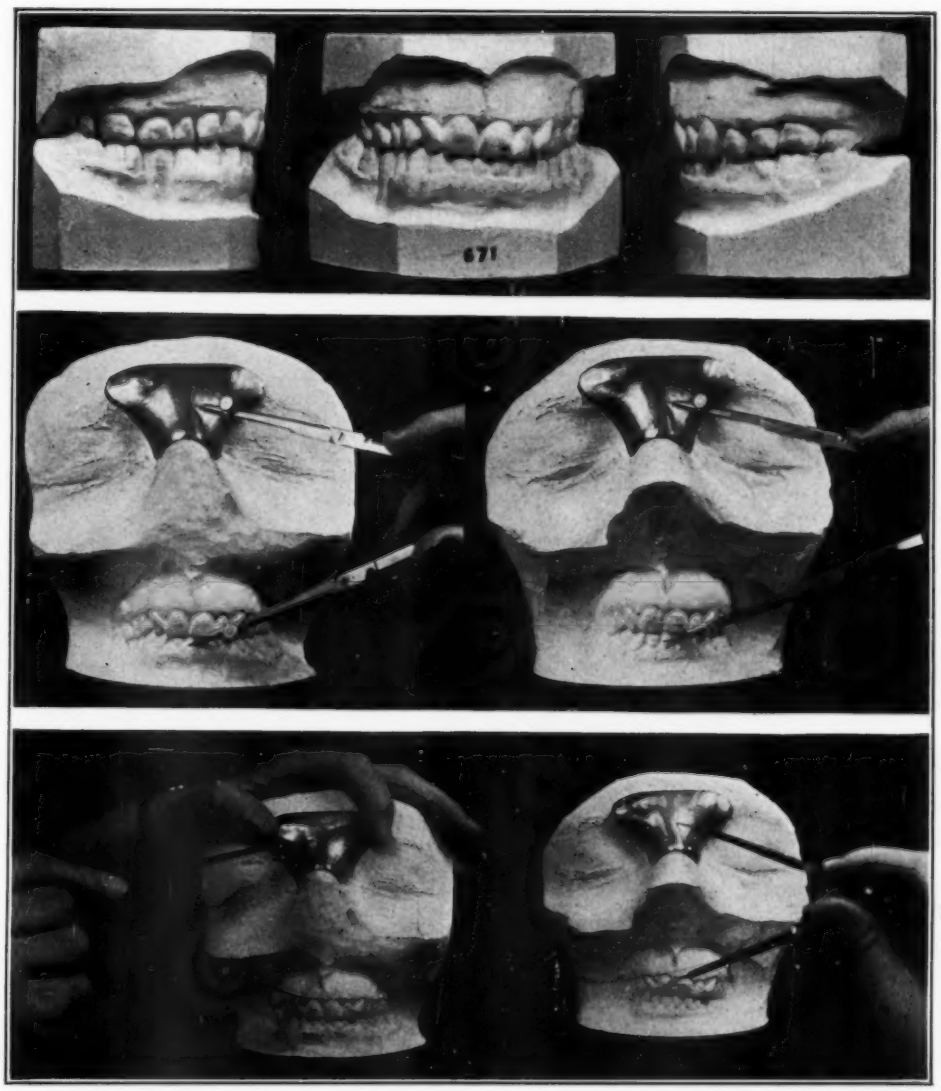

Fig. 10.

Fig. 11.

Fig. 12.

Fig. 10.—Third case, showing overbite developing following prosthetic elongation of posterior crowns. Note large occlusal onlays on mandibular molars and premolars.
Fig. 11.—Change occurred in the mandibular anterior region.
Fig. 12.—Change occurred in the maxillary anterior region.

to close a space left by a missing maxillary left lateral incisor. Later she consulted a dentist who decided to build up the posterior teeth in order to open the bite. The work was mechanically perfect, but the patient complained of a sense of heaviness and muscular strain. She then consulted another dentist, who referred the patient to me. In this case it was necessary to undo the work of the first dentist, and then proceed with the correction of the deep overbite.

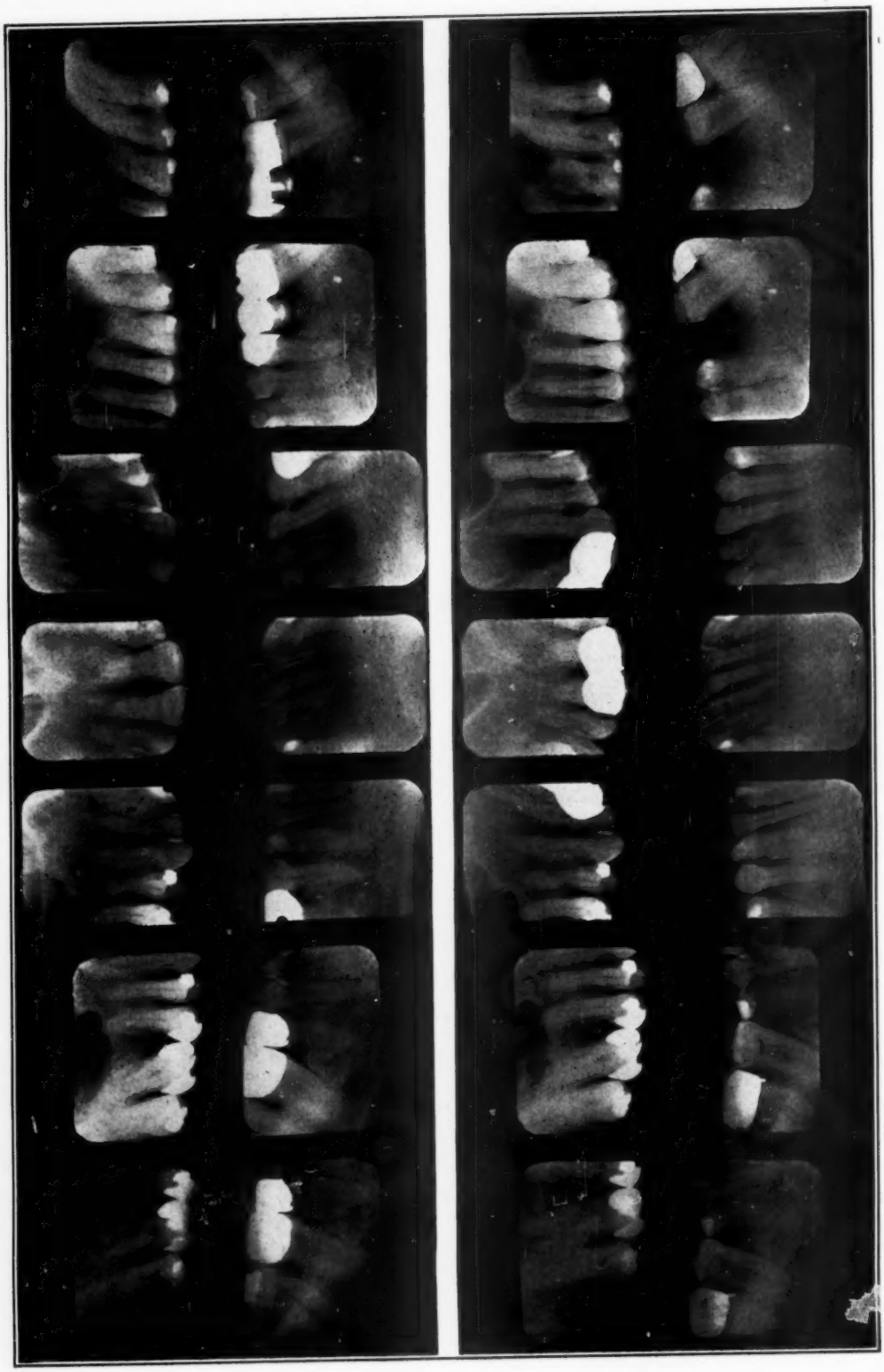

Fig. 13.—Radiographs before treatment.

Fig. 14.—Radiographs after treatment.

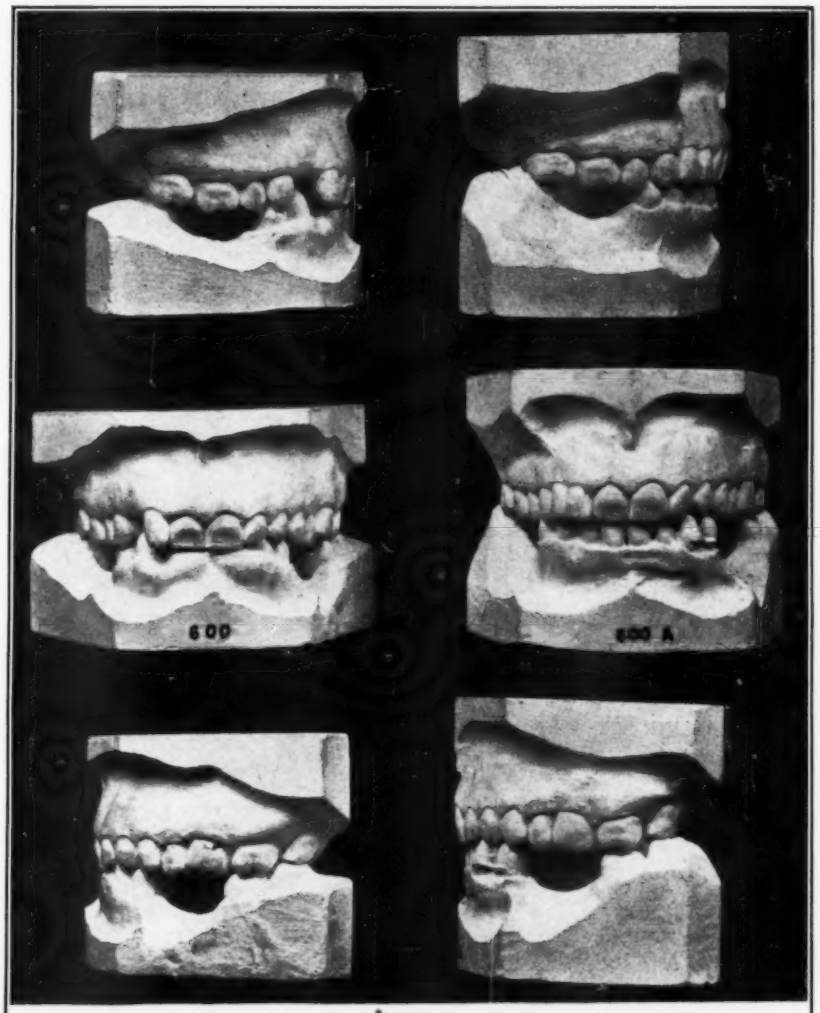

Fig. 15.

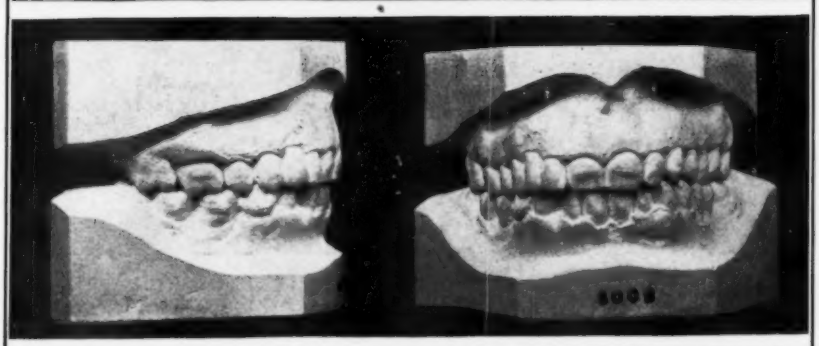

Fig. 16.

Fig. 17

Fig. 15.—Fourth case, showing deep overbite and correction at completion of treatment.

Fig. 16.—Showing insertion of restorations.

Fig. 17.—Mandibular casts illustrating original condition, condition immediately after retainers were removed and completed case, with restorations in place.

The fourth case (Figs. 15 to 21), male, aged thirty-eight years, deep overbite, Class I, was referred to me by a dentist who quickly recognized the futility of attempting extensive restorations with the possibility of obtaining balance. The dentist also was keenly appreciative of the periodontic implications of the deep overbite.

In the first case there was a change of 2.5 mm. in the maxillary incisors, and 3 mm. in the mandibular teeth; in the third case no change in the maxillary

Fig. 18.—Change in the maxillary anterior region.

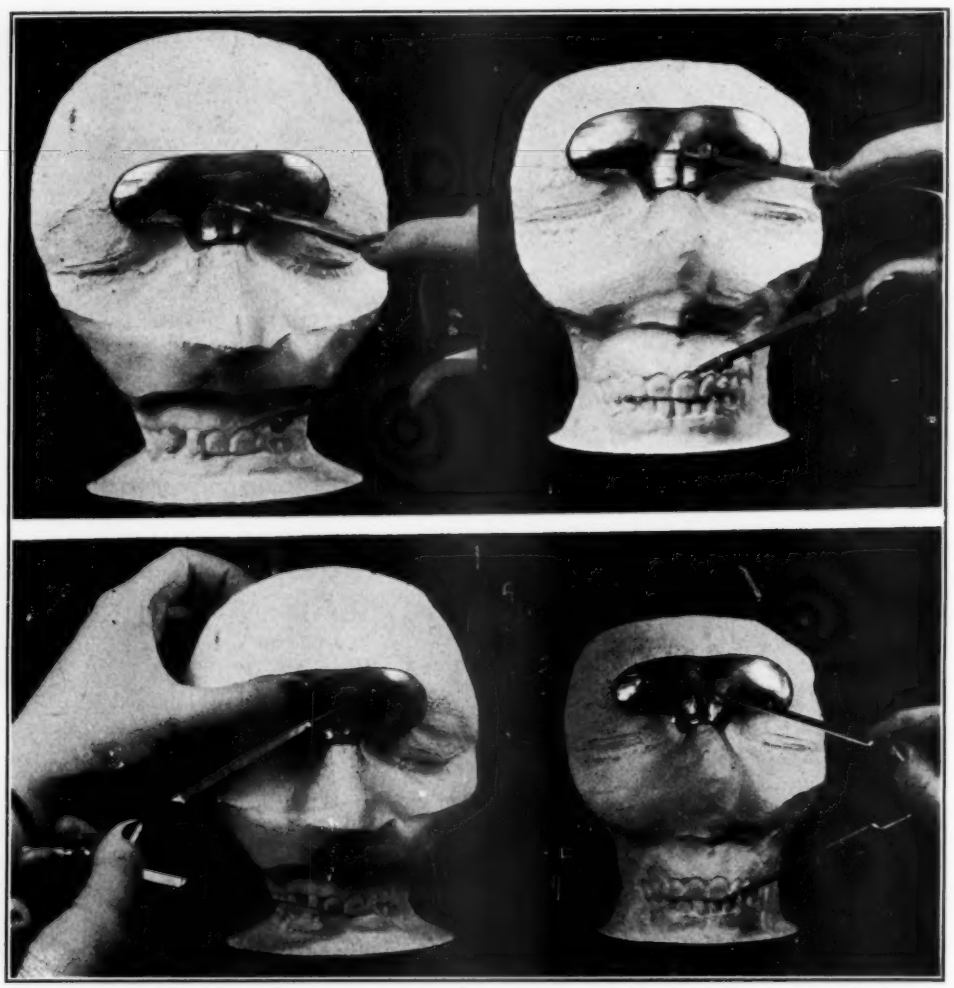

Fig. 19.—Change in the mandibular anterior region.

incisors and 1:75 mm. intrusion in the mandibular teeth; and in the fourth case, no change at all in the maxillary incisors, and an intrusion of 4 mm. in the mandibular anterior region.

CONCLUSION

In the material so far examined it would appear that:

1. Deep overbites of the type presented, upon treatment show a major change in the anterior region only, and apparently more markedly in the mandibular teeth.

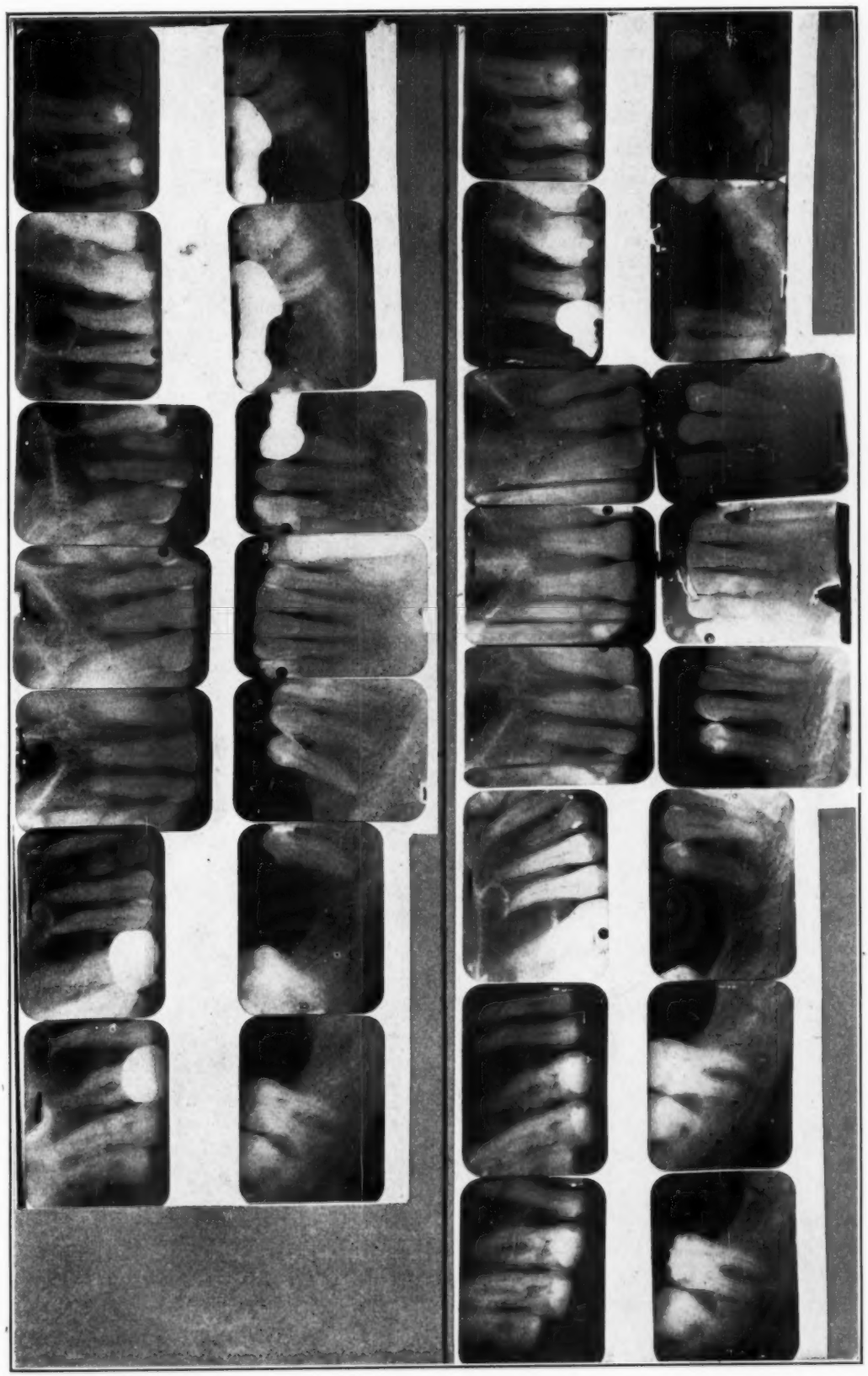

Fig. 20.—Radiographs at the beginning of treatment.

Fig. 21.—Radiographs at the completion of treatment.

2. The problem of vertical growth is one of excessive eruption of the anterior teeth, rather than a lack of growth in the posterior teeth.

3. Further studies are necessary to observe the relations of deep overbites to various types of cusp formations and jaw relations.

4. Continuous observation of these and of all other similarly treated cases is indicated to see whether the curve of Spee will be maintained.

As to why this sort of condition obtains, why there is an extrusion or apparently an over-eruption of the mandibular anterior teeth in these cases, I am not prepared to explain. I do not know.

Another question that I have been asked several times is, "Are these cases permanent in their results?" I do not know; I have not observed them long enough to know. I have observed them for only about three years.

Finally, I want to take this opportunity to pay tribute to the intuition, bordering on genius, of my teacher and friend, Dr. John V. Mershon. For years Dr. Mershon has been teaching the problem of the deep overbite, and many times stated that it is the mandibular anterior teeth that must be depressed. As in every other instance, I listen attentively always, but never accept what Dr. Mershon says until I check for myself; yet each time I attempt an investigation of his contributions, and more particularly when I attempt something new for myself, I find that Dr. Mershon knew all about it years ago.

ORTHODONTIA IN RELATION TO PROSTHODONTIA

JEROME M. SCHWEITZER, D.D.S., NEW YORK, N. Y.

THERE is no doubt that orthodontia could be definitely of more help to prosthodontia than it is today. There are many problems which the bridge-worker meets that definitely call for orthodontic aid. If the general practitioner were aware of the aid which the orthodontist could give him in some of his problems, those cases could be referred to the orthodontist to the mutual benefit of both the profession and the patient.

It is not entirely the fault of the prosthodontists that this help is not more often sought, for they have not been encouraged by the orthodontists to seek advice in that direction. Orthodontists are thought of as men who straighten the teeth of children. To read an article on any phase of orthodontia other than that which relates to the straightening of children's teeth, is rare indeed. One cannot, therefore, expect orthodontic advice to be sought in constructing difficult mechanical restorations. More men should be encouraged to procure help along those lines.

As examples of orthodontic help, the following problems may be discussed. A serious problem is the extrusion of the maxillary or mandibular posterior teeth as a result of premature extractions and failure to restore the opposing teeth. This extrusion when accompanied by the springing of the mandible at the angle (gonion) creates a difficulty for the prosthodontists which is not always easy to surmount (Fig. 1). When, due to this condition, the bite closes in the anterior region, the difficulty is even greater (Fig. 2). If the bite has not closed and the angle of the jaw has not straightened, the extruded teeth still present a problem which could be greatly benefited by a round table discussion. In the case of one or two extruded teeth, attempts are often made to grind them back to a more normal occlusion. In so doing, the enamel is often completely removed, and the occlusal anatomy destroyed. The teeth become very sensitive and cause considerable discomfort. This procedure, in many instances, causes pulp involvement. On the other hand, traumatic occlusion and lack of occlusal balance must be avoided, therefore grinding at present is by far the lesser of the evils. Why cannot the orthodontist prescribe some form of simplified treatment which would bring the offending members into occlusal harmony?

Another problem is that of tipping. This is a result of the failure to replace a missing tooth. The orthodontist is well equipped to deal with this type of case. It would be well if the general practitioner were aware that teeth which show a marked forward tipping can readily be moved back to their correct position before inserting a bridge. The finished bridge would be far supe-

Read before the New York Society of Orthodontists, New York, N. Y., March 15, 1937.

rior to one made on a tipped tooth. The line of force would be perpendicular to the long axis of the abutment tooth. If the tipped tooth is not first corrected, the force of mastication continually pounding the tooth in the wrong direction may cause periodontal disease. Attempting to parallel a tipped tooth is difficult as compared with the ease of paralleling an upright tooth. A tipped tooth at the very onset invites a mesial periodontal pocket.

Fig. 1.

Fig. 2.

Another confusing problem about which the orthodontist should more definitely advise the profession, is the missing permanent anterior tooth, particularly when that tooth is lost from the mouth of a young patient (Fig. 3). This presents quite a serious problem to the bridgeworker. Should the other teeth be moved forward, or should the space be retained and a bridge inserted? The orthodontists generally take different stands on this problem. Some advise moving the teeth forward and closing the space, while others insist upon maintaining the space and having a bridge inserted to preserve the occlusal harmony.

I often wish that all such cases could be solved by moving the natural teeth forward, in order to avoid bridgework of any form. Replacing the missing anterior incisor in the mouth of a young patient is a difficult task. To use a removable restoration means submitting the patient to such an appliance for the rest of his life, which, to me, seems needlessly cruel; whereas using a fixed restoration means the cutting of the thin adjoining teeth to secure adequate anchorage. It is also difficult, esthetically, to obtain the correct color. How-

Fig. 3.

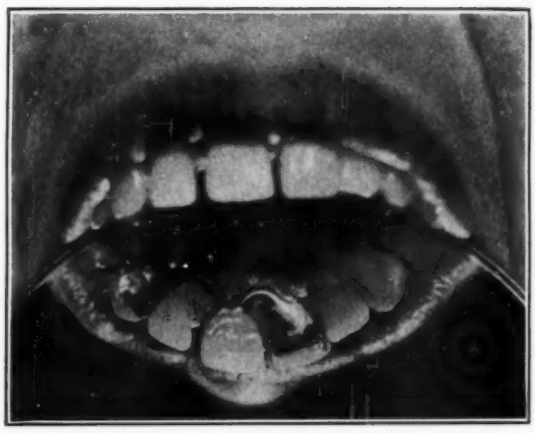

Fig. 4.

ever, if a bridge must be inserted, fixed bridgework is to be preferred. The initial operation may be more difficult than the removable bridge, but, if the fixed bridge is properly constructed, it will last longer and there will be less eventual destruction than with the removable bridge (Fig. 4). Another problem which is encountered if the patient is quite young, is the tendency of the space to close in spite of orthodontic help (Fig. 3). Therefore, a bridge is not advisable for a period of several years.

There is another type of case in which it is imperative that the prosthodontist consult the orthodontist, where it is almost impossible to restore teeth

without orthodontic help. Again, the men doing restorative work must be made aware, by literature and other means, that orthodontists are equipped and willing to help them.

The deep bite case, which Dr. Wolfson has discussed, is indeed a problem to the prosthodontist as well as the orthodontist, when restorations are necessary. Often, these deep bites must be raised by some mechanical procedure such as bridges or onlays before occlusal balance can be reached. If Dr. Wolfson's technique were generally accepted by the orthodontists, it would be a great help to prosthodontia. It is necessary, however, to be sure that there is no periodontal disease in the area of the anterior teeth before attempting this procedure of intrusion, otherwise the case will not be successful. In many cases of bite-raising in the adult, the orthodontist could work hand in hand with the prosthodontist. Sometime ago, a case presented itself in which I raised the bite without orthodontic aid, the result of which would undoubtedly have been better had this aid been sought. In closing this bite, the maxillary anterior teeth were moved outward and forward. The mandible was moved upward and backward. Therefore, in opening the bite by means of inlays and bridges, there was a large overjet at the conclusion. If a labial arch had been used before the anterior fixed bridge was inserted, the anterior teeth could have been brought back to their original position and the bridge could have been inserted at some later date.

In conclusion, may I suggest that orthodontists inform the profession by more lectures and more articles as to how they can further help the prosthodontist in order that they may work hand in hand in these cases, to the ultimate advantage of the patient.

DISCUSSION OF "DEEP BITE IN ADULTS" BY A. WOLFSON AND "ORTHODONTIA IN RELATION TO PROSTHODONTIA" BY J. M. SCHWEITZER

Dr. John V. Mershon.—I should like very much to open the discussion on this, although I hate to discuss papers by and large; but I first want to express my appreciation and thanks to Dr. Wolfson. We have had a great many conferences together, during which we have discussed this very problem. If Dr. Schweitzer will wait a little while I think he will find a paper which I presented before the Greater New York Meeting in December published dealing with this very subject. I presented one in Philadelphia about a year ago which led to the second presentation on this subject in New York. My papers were in a sense philosophical and were based on observations, ocular observations; while Dr. Wolfson's were based not only on clinical experience and observation but on measurements, which have a little more background than my observations and work have had. This is too big a problem, however, to discuss thoroughly at this particular time because it would practically amount to reading another paper, and that is never fair. But I do thoroughly agree with Dr. Schweitzer that the orthodontist can be of tremendous service both to the prosthodontist and to the periodontist.

I am not a child in the practice of dentistry. I have had a long experience in general work and in orthodontia; therefore I suppose I have had more failures than most men; but I cannot help noticing certain things. In a lot of slides that Dr. Schweitzer showed he said the periodontal membrane did not seem to be affected. I know that plaster models are very deceptive, but I believe if I could make an examination of those patients, the slides of whom Dr. Schweitzer was shown, almost every one of those cases had the periodontal membrane and surrounding tissue infected.

Now I will ask you to pardon a few personal allusions. One is that we have handled in our office—I was going to say almost hundreds of cases—many cases in which we have depressed the mandibular anterior teeth, where we have had mutilated cases, and where they have been full dentures of adults, and in the maxillary anterior teeth the infection was quite evident, and also in the mandibular there was evidence of some disturbance. We have depressed those mandibular anterior teeth, and I was so grateful to see the work that Dr. Wolfson has done because I have claimed—all of my claims are not borne out by measurements such as Dr. Wolfson has here—that the fault was in the mandibular anterior teeth. I have spoken of that and referred to it as an over-eruption of those teeth. I have no measurements by which I could prove it. Measurements on a human being are exceedingly difficult to obtain, but in so many of those cases after we have depressed those mandibular anterior teeth the deposits that were on there after they were cleaned off seemed to stop depositing, and those mandibular anterior teeth without any further treatment seemed to—well, the gums would hug up around the teeth; whether there was any further attachment I question, but they were healthy, and they remained healthy.

We always think of the irritation being in the upper. (I know I am getting a little far from the subject of open-bites, but this is very important.) Another interesting observation is that if you depress the mandibular anterior teeth in a child of ten or twelve years, or in that formative period, it almost invariably will have to be repeated over again once, twice, three times, because growth is still going on. Growth increases bulk and produces changes. But where we depress those cases in which growth is practically through, only that change that takes place as the result of growing old takes place. Too, in the older cases after we have depressed them once, we almost never have to retouch them.

In discussing it as a problem in prosthodontia, I think the mistake the prosthodontists make is that they have failed to analyze the tissues; that is, that muscle is the controlling factor in the length of the bite, also that teeth do wear down, and the bites can be opened only so far as wear has taken place. You cannot stretch the muscle. Bone you can change. I am very glad to have had the opportunity of listening to this paper. I think Dr. Wolfson has shown us something which is very valuable. I do not think I will be telling any tales out of school when I say that Dr. Ross is going to make a case report at the American Society meeting on some of the work that we have done in reference to these closed bites.

In conclusion, I think if the men in the prosthetic field will contact the men in the orthodontic field, and if the men in the orthodontic field would acquaint themselves with the facts and things that can be done in prosthodontia, we can be of mutual advantage to each other.

Dr. Sidney E. Riesner.—I should like to make an appeal to Dr. Wolfson—I am not including Dr. Schweitzer in this at this time because he is already practicing the observation of the temporomandibular joint—but since we have such an unusual opportunity of demonstrating the position, a new position, of the teeth, if we do not have any records of what occurs in the temporomandibular joint, we are passing up a valuable opportunity.

I should like to offer what little experience I have had in observing cases of deep bite in which there are manifestations of strain. Peculiarly, you will find instead of a recession or retreating into the mandibular fossa, that the condyle head is thrown posteriorly, not necessarily superiorly so much although there will be a little, but more posteriorly. This is a sure diagnostic factor of strain in occlusion, and will lend itself very readily to a changed position of the type that Dr. Wolfson demonstrated. The fact that these teeth have been in function for about three years after their change would be a splendid opportunity, even at this late date, to check their position and observe their reactions for future record.

Dr. Wolfson.—Is this an invitation to send these patients to you?

Dr. Riesner.—I will appreciate the courtesy.

Dr. Ashley E. Howes.—I cannot seem to get this quite straight. In the case before the last that Dr. Schweitzer showed the front views of before and after, he showed a patient in whom there was a definite fold in the lower lip; in other words, it showed almost an edentulous condition. He improved that appearance by opening the bite. Evidently that

was after he had secured an improved appearance besides improving the function of the teeth. I believe that if he had intruded those incisors that facial change would not have occurred. Too, in connection with what Dr. Riesner just said, I do not see how, if you intrude the incisors, you make any change in the temporal mandibular articulation. I just wanted to see whether I was mistaken in that or whether it can be explained.

Dr. Schweitzer.—I am sorry I was not able to show you the other slides I have. I did not want to take up too much time. One of them shows the posterior relationship. What I did say was that if the maxillary teeth were treated the way Dr. Wolfson suggested, and were intruded 2 or 2.5 mm., or even 3 mm., I would not have had to put the mandibular teeth on stilts; I would not have had to overbuild them. The posterior relationship was such that had I originally opened that too much I would have had to take the condyle too far posteriorly or bring it out of the glenoid fossa entirely. I think the original x-ray pictures would have been very interesting, but I did not have a chance to show them. I think the intrusion of those teeth would have permitted me to put a labial arch on there before the anterior fixed bridge was inserted, and in that way the anterior teeth could have been brought back to their original position, and the bridge could have been inserted at some later date, and I would not have had to open the bite too much.

President Barber.—I believe Dr. Howes had another part to that question, Dr. Schweitzer. He asked that if you had intruded the mandibular anterior teeth instead of raising the bite in the back what effect would it have had on the facial expression, is that right?

Dr. Howes.—And on the temporal mandibular articulation.

Dr. Schweitzer.—As far as the facial expression goes, I do not think we would have obtained as good a result if those anterior teeth were intruded, because the bite would not have been opened as much; but as far as the temporal mandibular articulation is concerned, from my own little knowledge, I do not think we would have had to take the condyle out of the glenoid fossa, nearly as much, and it would have been better for the patient. As Dr. Mershon said, I believe we overstretch those muscles; although the late Dr. Munson, I am afraid, disagreed and said we could stretch them by—I do not know how much. In my cases at best I try to combine esthetics and function, and if function interferes with esthetics I take a little from esthetics and prefer not to have them look so well but function correctly.

Dr. Abraham Wolfson.—I think in the case Dr. Schweitzer presented, about which a question was raised, that there are two factors involved which we must keep clearly in mind. One is that closure which is due to the wearing of teeth occlusally. That, and that alone, is actually an instance of closure from an original dimension which once existed in that patient, and you are quite justified from the prosthetic viewpoint in opening up to that original dimension, whether you use large inlays, or stilts, or what not. I am now quoting completely from Dr. Mershon's paper: where you go beyond that point you are putting the muscles of the face upon a stretch. They tend very persistently to come back to their original dimension, and little by little something is going to give. If the periodontal tissues are very tough, there is going to be merely occlusal wear; but when the restoration is very firm, there is actually going to be a weakening or breaking down of the periodontal tissue. In my presentation I did not try to deal with the question of closures, or the opening of closures. I merely was dealing with a distortion in the curve of Spee, not attempting to influence the length of the facial muscles. There is that definite distinction that ought to be made.

President Barber.—On behalf of the Society, I want to thank you, Dr. Schweitzer, as our guest, very much for your wonderful presentation. You mentioned how much the prosthodontists, in doing this sort of work, in restoring lost teeth, etc., could be helped by the orthodontists; and I think the converse is true: that if a great many orthodontists knew what wonderful work could be done in cooperation with prosthodontists both would be contributing a very great deal to the public.

Dr. Wolfson.—Could I ask the courtesy of the Chairman to call upon Dr. Weinmann for a few minutes discussion? Dr. Weinmann is the gentleman with whom I worked on the last case. He is particularly interested in periodontal problems, and has some very definite ideas on the closed bite in relation to periodontal disturbance.

Dr. Isadore Weinmann, Newark, N. J.—I was very much interested in the remark made by Dr. Schweitzer when he said that intrusion of anterior teeth should not be attempted in the presence of periodontal disease. It has been my experience that periodontal disease indicates that form of treatment for several reasons: First, there is not the resistance that good, normal, healthy bone offers. The case comes under control much quicker, and the sooner the case is put under control the more rapidly will be the repair of the tissue. The mere fact that there is a sick condition of the surrounding structures at the time is no reason to forego that treatment, because it is a treatment of repair. There is already destruction present, and in the hands of a periodontist that can be very easily controlled.

It so happens that before I submitted these cases to orthodontists I struggled a long time along similar lines from the standpoint of the general practitioner; and it seems that the best results were obtained in severe periodontal disease, that the failures I encountered were in good, healthy, normal alveolus, where I did have absorption of the cementum.

CONSTITUTION, HEREDITY AND ORTHODONTIA

H. Berger, Dr. Med. Dent., Tel-Aviv, Palestine

THE science of constitutionality even today plays only a rather small part in orthodontic etiology, and its part is a still smaller one in orthodontic diagnosis. But it is a grave mistake to see only the mouth with its correct or incorrect denture, or perhaps in its relation to nose and chin. Also it is not sufficient to consider the whole face on the basis of graphic or photographic records. We must see and examine the entire body if we would make further progress in our science. During the past ten years, I have been trying to bring the entire body and its appearance in relation with orthodontia, and I shall give a short theoretic view of the matter.

If the orthodontist would broaden the dental arches, he has to decide upon the measure of the right breadth; this measure is taken from the sum of the diameters of the maxillary anterior teeth along the methods of Pont, Hawley, etc. But why determine the width of the alveolar arch along the breadth of the anterior teeth and why give all children *one* normal shape of arch without considering whether there are children with broad faces or long and narrow faces, if there are children of broad type or of a high and narrow type? For the head and the face are only one part of the body which in its totality is subjected to one principal feature. This division into many types has often been referred to as the difference in the shape of the jaws, of the face, of the skull, but has so far not resulted in a practical application. In his recent lecture Prof. Hrdlička states: "Besides this normal variation there is noticeable also, in many, if not all the more definite features of the human organism, a tendency toward a segregation into more than one type. . . ." More than *one* type. . . ! But how many? If we want to be thorough, we shall find that each individual has his own type; and if we construct some ideal types, we shall find that no living individual resembles one of these types. Nevertheless, we must try to find a solution, and, therefore, I shall demonstrate two contrary types, to sharpen our eyes to that which is essential for our task.

If one looks at Figs. 1 and 2, one will scarcely feel the necessity of a detailed explanation. But I shall nevertheless depict in a few words these two contrary types, the pyknician and the leptosomian, as they have been described by Kretschmer. Characteristic of the leptosomic type is a diminished growth in breadth; whereas the growth in length is undiminished in the average. To this tendency are subjected all parts of the body, face, neck, trunk, extremities. In the external appearance the leptosomian is a meager, thin, tall individual with small shoulders, slim arms and hands, and a long, small flat chest.

The pyknician is generally the contrary of the leptosomian. He is of middling size, with a broad face on a short neck nearly between the shoulders, and a compact trunk. The hands are more short than broad. A third type is the

athletician (Fig. 3). He is of medium or tall size and has skeleton, muscularity, and skin likewise strongly developed. His broad shoulders and his strong chest are greatly significant.

It is of extreme importance that the form of face and skull correspond to the trend of the rest of the body. The face appears to Kretschmer to be the calling card of the body's constitution; thus the leptosomian's soft face is covered by a thin, pale skin, and when in some cases the zygomatic bone seems to stand out, not a strong bone is prominent, but the thin integument is transparent. Actually, the breadth of the zygomatic bone (which is coincident with the physiologic breadth of the face) is the lowest of the three types, i.e., lower than that of the pyknician and also of the athletician. The face is therefore generally small and

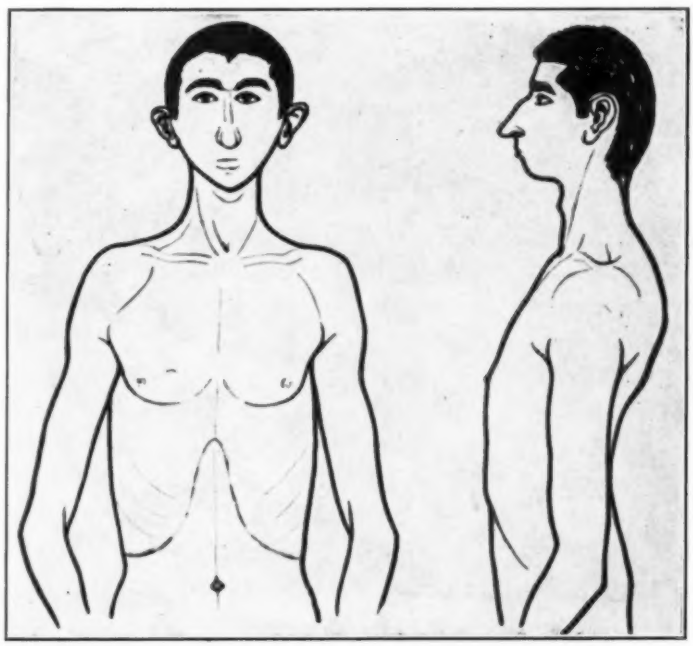

Fig. 1.—Leptosomian type. (After Kretschmer.)

high; whereas that of the pyknician is more broad and not so high. I shall return to this problem in greater detail.

Here we shall further examine briefly the different profile forms. The leptosomian's profile is dominated by the disrelation between an increased length of nose and middle-face and hypoplastic form of the lower jaw. This typical leptosomic profile is called by Kretschmer "angle profile," and it stands in strict contrast to the pyknic profile which is of a rather small curvation. Kretschmer writes in this connection: "The mutual relations in the height of forehead and middle-face, nose and chin are generally very harmonious and, in their proportions of measure, can directly serve as index for mean values." A principal feature in the athletician's face is the most developed lower jaw with its chin. If, from this point of view, we look to Simon's gnathostatic norm-method, we can easily see that his orbital plane law and its alleged relation to the gnathion will be accurate only for the pyknician's harmonious type of face,

which in its proportions of measure "can directly serve as index for mean values." We, in our practice, have to do with children of all types and especially, because children of pyknic type are in a rather small proportion, it is obvious that each diagnostic system which is based on "norm values" must force a treatment which does not have regard for the special type and therefore may not be appropriate to it, whether in regard to its exterior appearance or in regard to the static structure of the skull. Since we realize these facts, we are confronted with the problem: whether these types are sufficiently distinguished from each other so as to serve us in our task of *individualizing the norm.*

That we scarcely will meet the above referred types in their ideal perfection has already been said. The great majority of individuals unite in their figures, elements of the different types. Nevertheless, we will generally be able to classify an individual along the preponderance of his main features.

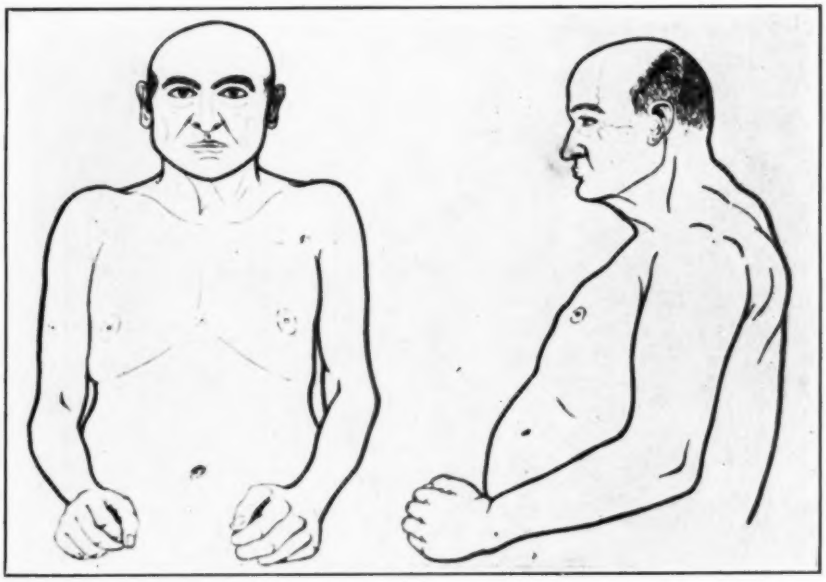

Fig. 2.—Pyknician type. (After Kretschmer.)

Kretschmer himself—though a psychologist, and no dentist—has introduced into his work the term "alloy" for these individuals. As we are familiar with this term, we can easily imagine its significance in this connection.

But in one relation these "alloys" may be of greatest interest to us: if teeth of broad pyknic type appear in persons of generally leptosomic type and equally narrow leptosomic jaw. Much has been written about "the broad teeth of the father and the small gum of the mother," yet this theory has on the other hand been spoken of as a "fairy tale." Only recently Hrdlička wrote: "These are assumptions backed by no scientific determinations. There are innumerable hybrids between the whites and the negro, the whites and the Indian or Eskimo and between other races; yet no disharmonies are perceivable in any of these under normal conditions. According to all indications the normal heredity of the teeth and the jaw is, aside from what is sex-linked, a blend heredity as that

of many other, and particularly epidermal features of the body, and not the simple Mendelian inheritance with its dominance, recessiveness, and segregations."

I wonder why just in the particular case of the teeth and jaws the "simple Mendelian inheritance" may not occur. On the contrary, it may well be that it does occur. Not only is it "not simple" but it is decidedly complicated. Before I attempt to analyze this somewhat intricate matter, I shall quote some other authors in answer to the above cited points. As to the "blend heredity of particularly epidermal features," there is nothing more affiliated to the epidermis than the hair. But when Eugen Fischer examined the "bastards of Rehoboth" —hybrids between male Boers and female Hottentots—he found typical *fil-fil*-hair in *light* color. The hair *form* was inherited from the mother, the hair *color* from the father. But when there are "disharmonies" in the hair which is totally

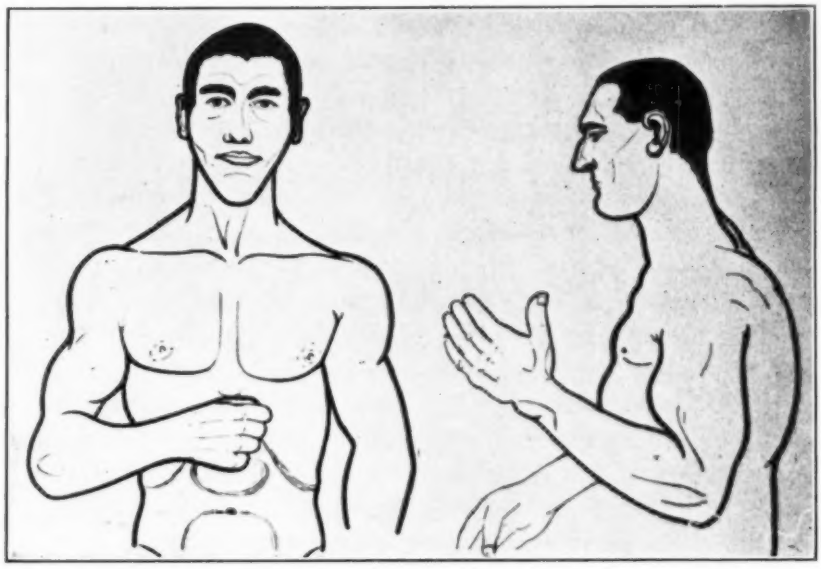

Fig. 3.—Athletician type. (After Kretschmer.)

derived from the epidermis, i.e., from the ectoderm, why should these "disharmonies" or "alloys"—I have previously spoken of—not occur in the case of teeth and jaws, only the former being developed by the ectoderm, the latter by the mesoderm? Besides the hair disharmonies, Fischer found also, for instance, ears and noses composed of many different parts of European and Hottentot origin. In Fischer's research, which dates back some twenty years, we find no special reference to jaws and teeth. And, though, after his above cited findings we may not doubt about the possibility of a mixed composition of jaws and teeth, I cannot but quote a work of Abel, who recently examined this special relation on a corresponding material, involving hybrids of Bushmen, Hottentots and Negroes. Some of his results are given in Table I showing also the more detailed composition of his material.

We see from Table I that the alveolar widths of these particular groups are distinctly different from each other. Bushmen and Hottentots have a smaller alveolar width than the Negroes; whereas the hybrids show middle values (but

nearer to the small ones of Bushmen and Hottentots). The author states that also the teeth of these groups show similar differences. We must therefore expect that the segregated inheritance of teeth and jaws of different size will produce anomalies.

TABLE I

GROUP	NUMBER OF SKULLS	ALVEOLAR WIDTH (MEAN VALUES)	
		Lower jaw	*Upper jaw*
1. Bushmen of relatively pure race	14	48.6 mm.	50.1 mm.
2. Hottentots of relatively pure race	44	49.1 mm.	50.5 mm.
3. Hybrids			
a. Preponderantly Hottentots crossed with Bushmen or Negroes	15	51.7 mm.	53.0 mm.
b. Bushmen crossed with Negroes preponderantly	23	52.7 mm.	54.5 mm.
4. Negroes of relatively pure race	7	58.5 mm.	60.5 mm.

Indeed, Abel writes about this point: "Worthy of particular remark are the relations of the jaw and alveolar arch to the teeth in hybrids where often in the jaw a great lack of space for the teeth is to be found. The great differences in the form and size of the jaws and teeth have made it possible to explain, especially in three cases, the lack of space through mixture of a small Hottentot jaw (in one case) and Bushmen jaws (in two cases) with large Negro teeth. In another case are, on the contrary, the small teeth of a Hottentot distinctly to be found in a broad Negro jaw. In the first 3 cases anomalies of the denture had occurred in consequence of the lack of space. Thus in one Hottentot-Negro-Hybrid the left lower incisor was displaced and an embracing anomaly of the second denture had resulted especially in the incisor and cuspid region. In two Bushmen-Negro-Hybrids, once in the lower jaw, once in the upper jaw, the cuspids of both sides have been prevented from erupting and have been retained in the jaw. Beyond these most outstanding cases of lack of space, also in several other cases in hybrids oblique positions of cuspids and incisors as well as torsions were to be found." Therefore the author comes to the conclusion that the size of the jaws and that of the teeth is inherited in a separate manner.

To conclude these investigations I will also briefly refer to the results of the crossing of a Ceylon-naked-dog with a dachshund as reported by Gaspar. There were bred three generations with 33 individuals, 22 of which were fit for examination. Different features of the dogs' heads are: the nasal section of the dachshund is narrower than that of the naked-dog. The zygomatic bone of the dachshund lies close, that of the naked-dog stands off. The palate of the naked-dog is divergent backward; whereas that of the dachshund is not to such an extent. Gaspar concludes that "the head-forms of the bastards are of great variety, especially since in the process of crossing nearly all bone-parts are segregating individually and independently." Completely new types result from these combinations. Gaspar exemplifies this fact by referring to two special bastards (No. 25 and No. 31), and it is of the greatest interest that especially in these two cases anomalies in the denture too have occurred. Gaspar writes: "A fine proof for the influx of the jaw-formation on the position of the teeth is the fact, that at the individuals 25 and 31, where the general form of the head and the separate parts resemble one another, similar alterations in the denture

have also occurred. The left lower incisor is forced to erupt in a backward displacement.'' Gasper comes to the same conclusion as Abel: ''The abnormal position of the teeth is a result of the crossing. It is possible that sometimes the upper or the lower jaw is too broad, and if, for instance, the jaw of a bastard is too narrow, some incisors are forced to erupt before or behind their neighbors or with a torsion.'' I will return to this interesting experiment later. But I think it is now the time to state that we cannot doubt the separate inheritance of teeth and jaws. If we may not doubt about this inheritance, we must try to explain its occurrence along the generally accepted laws.

It is known, we think, that each inheritable quality is localized in a last little unit, the ''gen,'' and that, for each quality of an individual, there are two gens since the individual gets one gen from the father and one gen from the mother. These two gens do not intermingle but they continue to exist side by side, and at propagation the one or the other gen will be carried on. We will state the possibilities of inheritance between an individual having the homozygotic disposition for broad jaws and broad teeth, and an individual with the homozygotic disposition for small jaws and small teeth. (''Homozygotic'' means that the individual received the same gens from father and mother.) From the crossing of these two individuals proceed in the *first* filial generation individuals which received, from the one part, the gen for small jaws and from the other part the gen for broad jaws, and likewise a gen for small teeth an a gen for broad teeth. If we suppose that none of these characteristics is dominant, there will result in these individuals a medium breadth. But we will get completely different results if such an individual of the first filial generation is crossed with another, which also has heterozygotic gens for jaws and teeth. For in the *second* filial generation the characteristics will segregate and there will be 16 different possibilities for the combination of the gens.

TABLE II

P-Generation:		JJTT	jjtt	
F_1-Generation:		JjTt		
F_2-Generation:	$JJTT_1$	$JJTt_2$	$JJtT_3$	$JJtt_4$
	$JjTT_5$	$JjTt_6$	$JjtT_7$	$Jjtt_8$
	$jJTT_9$	$jJTt_{10}$	$jJtT_{11}$	$jJtt_{12}$
	$jjTT_{13}$	$jjTt_{14}$	$jjtT_{15}$	$jjtt_{16}$

(J and T mean broad jaws and broad teeth, j and t, small jaws and small teeth.)

It is easy to bring these 16 combinations of the F_2-Generation into 4 groups. (Table III.)

TABLE III

I.	1	Individual with large jaws and large teeth(1)
	1	Individual with small jaws and small teeth (16)
	4	Individuals with medium jaws and medium teeth (6, 7, 10, 11)
II.	2	Individuals with large jaws and medium teeth (2, 3)
	2	Individuals with medium jaws and small teeth (8, 12)
III.	2	Individuals with medium jaws and large teeth (5, 9)
	2	Individuals with small jaws and medium teeth (14, 15)
IV.	1	Individual with large jaws and small teeth (4)
	1	Individual with small jaws and large teeth (13)

The *first* group contains normal cases: we find 1 individual with large jaws and large teeth, 1 individual with small jaws and small teeth, and 4 individuals with medium jaws and medium teeth. The *second* group contains 2 individuals with large jaws and medium teeth and two individuals with medium jaws and small teeth. As in these cases the jaws are a little larger than expected in relation to the teeth, a compensation will easily proceed and we can speak of these four cases as "almost normal."

Inverted is the relation in the *third* group, where we find, on the contrary, two individuals with medium jaws and large teeth and two individuals with small jaws and medium teeth. As in these cases the jaws are smaller than necessary in relation to the teeth, and as lack of space in this region is greatly disadvantageous, these cases will be anomalies.

Extreme anomalies are found in the *fourth* group: too large teeth in too small jaws and too small teeth in too large jaws.

It is most remarkable that we find in this grouping five anomalies in which are too large teeth in too small jaws, and only one anomaly (No. 4) which will strike us as a disrelation of too small teeth in too large jaws!* This statement may overcome the often heard argument: "There cannot be a separate inheritance of teeth and jaws, for we so often see overcrowded dentures with lack of space and very seldom dentures with interspaces and surplus of space." The number of cases which may strike us as "too small teeth in too large jaws" does not correspond to the number of cases which we speak of as overcrowded and which we decide to broaden. But it corresponds to the number of those cases of overcrowding in which we must state a disrelation between the size of the too large teeth and the too small jaw (in connection with a small face and a leptosomic body!) to such a degree that we must decide upon *extraction!*

I know there are authoritative opponents as to the right of extraction in orthodontia. The utmost concession they will make, are cases of underdevelopment after serious diseases during childhood or cases in which the advanced age of the patient may compel us to resort to this solution. I have demonstrated previously that, simply in the course of inheritance and in consequence of it, cases of disproportion may proceed where we *must* extract if we wish to give our patient a denture which is suitable for his special type! For, if we do not extract, we will create a denture which is abnormal for the individual not only from an esthetic but also from a static point of view: in a small leptosomic patient the jaw will not be sufficiently broad to serve as a base for an extremely broadened alveolar process which contains a complete denture of 32 teeth—the breadth and size of these are in disproportion to it. (Here is a strong point of contact with Lundstrom's theory of the "apical base.") There is, as far as I know, no diagnostic system which allows us to recognize such "anomalies of combination." I dare to offer such a *diagnostic system along the principles of heredity.* It comprises only three divisions:

*This scheme is based on the assumption that none of these inheritable qualities is dominant. But we are entitled to believe that small jaws may be dominant over broad jaws. We find in the literature references that a small face is dominant over a broad face (Scheidt) and also, in Table I we have already stated that in the hybrids, the breadth of the jaw was no medium one, but always nearer to the lower measures. The same result follows from an analysis of the crossing of dogs, given in Table V. Under these circumstances, the disrelation between dentures with lack of space and dentures with excess of space may be still greater in favor of the former.

I. *Anomalies of modification.* These are anomalies which have no hereditary causes but merely environmental ones. For instance, anomalies caused by early loss or extraction of teeth, by thumb-sucking and other habits, by diseases, such as rickets (open-bite) and so on.

II. The second division contains "*anomalies of combination.*" These are the anomalies we have already spoken of and which result from the combination of incongruous features, inherited from the parents.

III. The third group contains the "*anomalies of mutation.*" In the science of heredity a mutation is a variation in the idioplasma which takes place at any time for any reasons (idio-variation) and which consequently changes the secondary features. Such a mutation is inheritable, and we may name "anomalies of mutation" all these, or better, these few anomalies which, along our present modest knowledge of human heredity, are inheritable anomalies, as, for instance, spacing between the maxillary central incisors, mandibular prognathism, excessive overbite and anomalies which are produced by supernumerary or missing teeth.

Of course, the anomalies will not always be pure ones corresponding absolutely to our three groups; nevertheless we may be able to classify them along their mean feature. For cases, however, which may not be grouped among one of our three classes, we may have in reserve a fourth class of *complex anomalies.*" I am conscious that with our present limited knowledge of etiology, it will be difficult to operate this system which is founded on the principles of constitutionality and heredity. I think, however, this fault is also a gain: it is sufficiently comprehensive and elastic to allow us to group and to regroup anomalies along our newly acquired or changed experiences; and, most of all, this system will force us to acquire new knowledge, since it will force us not only to look at the denture and at the face, but also to see the whole of the body. Thus we may find new relations and we shall make further progress.

I shall not conclude without returning once more to the "anomalies of combination." For I believe there will be some difficulties in the beginning. Therefore, I am glad to offer a remedy which may be of assistance in our work; I have been using it with success during the ten years since I found it in 1926.

The "anomalies of combination" being a disproportion between the denture and the body, it was necessary to establish a proper relation for them. There have been many attempts to discover such relations, i.e., relations between the form of the alveolar arch and the form of the face or head. (After the former remarks, it goes without saying that we must discard all methods which define the height of the alveolar arch along the breadth of the maxillary anterior teeth, as promoted by Hawley, Herbst, Pont, etc.)

All these attempts to bring into relation the face or head with the maxillary arch had failed, and in 1925 I tried to find such a relation myself. The former authors having tried to bring into relation the shape of the face or the head or their different indices with those of the denture or the alveolar arch, I confined myself to establishing a mere breadth relation, as most of all such a one seemed to me to be necessary for our work.

As to the facial measure, I found, after a thorough examination, the "maximum zygomatic breadth" the most convenient for our task.

1. The points of measurement are sufficiently distant from our region of work so as to be influenced by the changes produced by our treatment (*stability*).

2. They are, on the other hand, both statically as well as functionally connected with the maxilla, and we must therefore suppose that this connection resulted in a standard relation which is also—I hoped—a numerical and measurable relation (*functional and statical relation*).

3. The "maximum zygomatic breadth"—anthropologically speaking—represents also the "physiologic breadth of face," and therefore a zygomatic relation will guarantee us not only a statically and functionally but also an esthetically based method (*esthetic relation*).

4. Last but not least: the measurement is easily taken.

For taking the measurement of the maximum zygomatic breadth, we use an anthropologic circle. With the ends of the calipers held between thumbs and

Fig. 4.—Measurement of the maximum zygomatic breadth.

forefingers, we glide along the zygomatic bones and observe when there appears the greatest measure.

As measure of the breadth of the maxillary dental arch, I chose the distance between the centers of the first permanent molars. These points of measurement are also used by Pont, and I accepted them in order to have the possibility of comparing my new method with that of Pont as to their exactness. Before I

TABLE IV

	MAXIMUM ZYGOMATIC BREADTH		BREADTH OF THE PALATE (INDICES)		
	Male	*Female*	*Male*	*Male & Female*	*Female*
Japanese	130—136—141	---	77.6	----	
Fan	137	---	77.3	----	81.7
Eskimo	142	136	----	84.3	----
Tyrolians	142	134	91	----	91.5
Chinese	144	---	----	92.2	----
Kalmücks	151	---	----	92.9	----
Buriates	153	---	----	94.4	----

started my investigation on individuals with normal dentures, I took from the anthropologic literature (after Martin: *Lehrbuch der Anthropologie*) some measures of the zygomatic breadth and compared them with their respective indices of the palate (absolute measures of the palate were not available).

If we look at Table IV, we can state a proportional increasing of both the zygomatic breadth and the index of the palate. It is interesting, in this connection, to return to the crossing experiments of Gaspar and to pursue the measures of the zygomatic breadth and of the breadth of the palate through the four generations (Table V).

TABLE V

P									90	×	71										
									39		36										
F_1				87					70				73								
				38					34				36								
			87	×	73									87	×	?					
			38		36									38		?					
F_2	72	71		71		69	70		68						79		69		66		
	33	33		32		32	34		33						?		35		32		
				79	×	73									79	×	71				
				?		36									?		32				
F_3		69		64		64				72						65					
		34		33		?				36						31					

The figures of the upper lines represent measures of the zygomatic breadth, those of the lower lines the measures of the breadth of the palate.

In Table VI mean values for each generation have been calculated, and they show a corresponding decrease of both measures.

TABLE VI

GENERATION	MAXIMUM ZYGOMATIC BREADTH	ALVEOLAR BREADTH
P	80,5	37,5
F_1	76,6	36,0
F_2	70,6	33,0
F_3	66,8	33,5

But the true numerical relation was revealed only through the investigation of 30 adult persons with complete and normal denture (European population.)* In this connection I think it sufficient to give a short summary of the results with the help of some diagrams. It resulted from the investigation that *the distance of the first maxillary molars* (measured between their centers) *is one-third of the maximum zygomatic breadth.*

Fig. 5 shows the 30 cases grouped along increasing zygomatic breadth (upper line). We also see that the second line, the curve of the alveolar breadth (distance of the first molars), is increasing; whereas the three lower lines (distance of the first bicuspids, distance of the cuspids, and sum of the breadth of the

*Those especially interested in these questions are referred to my publication No. 2 of the references.

maxillary incisors) are irregularly formed and have no relation either to the zygomatic or to the alveolar breadth.

In Fig. 6 the 30 cases are grouped along the deviations of the molar distance from the third part of the maximum zygomatic breadth. If we analyze this frequency-polygon, we find the character of a binomial curve (after Quetelet, the sign for the variations of a norm) and we state, further, that the peak of the curve falls between 0 and +2 mm. If we accept a breadth of variation of 2 mm. as a physiologic one, we see that 23 out of our 30 cases, or 76 per cent, satisfy our newly established relation. In contrast to the significant form of this polygon the polygon which, on corresponding base, is derived from the Pont-method shows completely irregular form (Fig. 7). Its width of variation is 11 mm., that of the *zygomatic method* only 6 mm. Its average mistake is 2.02 mm. against 0.94 mm. of the zygomatic method.

I have previously stated that these measures were taken in adult individuals. It goes without saying that the whole method would be without practical significance for us if it would not also cover the period of adolescence. At first glance, it seems not to cover, if we compare Tables VII and VIII.

TABLE VII

INCREASE OF MAXIMUM ZYGOMATIC BREADTH (AFTER MARTIN)

AGE	GERMAN, SWEDISH, ETC. (RÖSE)		SCHAFFHAUSER (SCHWERZ)		HINTERPOM. (REUTER)		ST. LOUIS (TORTER)		WORCESTER (WEST)	
6	117	116	116	114	119	116	118	116	114	114
7	119	117	118	117	120	118	119	118	117	114
8	120	118	118	117	122	119	120	118	116	115
9	121	119	121	118	124	122	122	120	120	117
10	123	121	122	119	126	127	123	121	120	118
11	124	122	123	121	125	121	124	122	121	120
12	125	124	125	123	128	125	126	124	122	122
13	127	126	126	124	128	126	127	126	124	123
14	128	128	129	127	130	---	128	128	126	125
15	---	---	128	129	---	---	130	130	129	126
16	---	---	129	129	---	---	132	131	130	126
17	---	---	135	---	---	---	135	131	130	127
18	---	---	136	---	---	---	---	130	134	129
19	---	---	138	---	---	---	---	131	133	129
20	---	---	138	---	---	---	---	---	136	129

TABLE VIII

INCREASE OF ALVEOLAR BREADTH (AFTER FRANKE)

AGE	FORWARD ALVEOLAR BREADTH	MEDIUM ALVEOLAR BREADTH	BACKWARD ALVEOLAR BREADTH
6- 7	40,3	41,6	42,9
8- 9	41,7	43,4	45,0
10-11	42,6	44,2	45,7
12-13	42,7	44,8	46,9
14-15	42,4	44,4	46,3
16-17	43,8	46,2	48,5
18-19	43,8	46,3	48,8
20-21	44,6	46,5	48,4

For the increase of the zygomatic breadth is on an average of 20 mm. for a period of fourteen years (Table VII); whereas the increase of the medium alveolar breadth (which corresponds to the alveolar measure used by us) is only 5 mm.

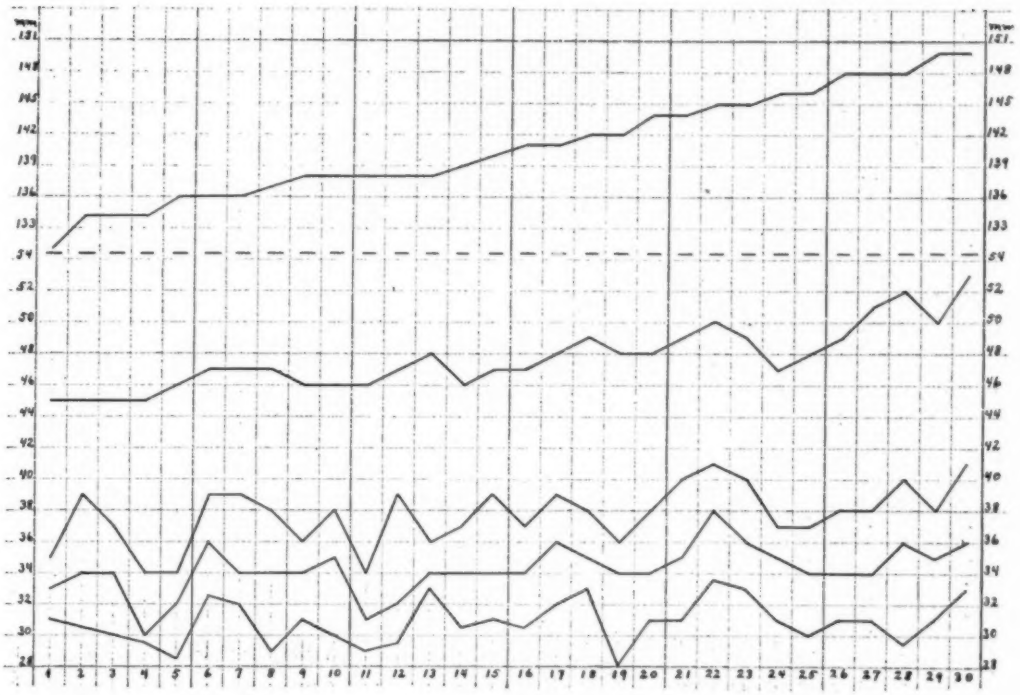

Fig. 5.—Curves of the sum of breadth of the maxillary incisors, of the distance of the cuspids, the first bicuspids and the first molars, and of the maximum zygomatic breadth.

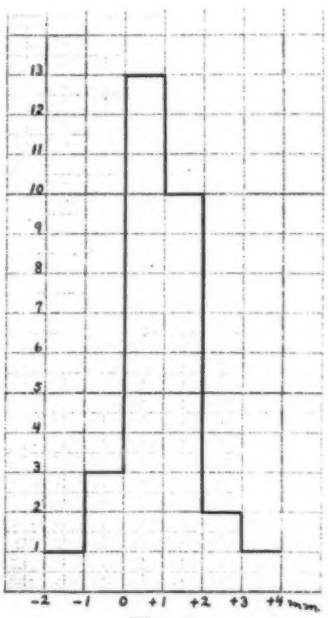

Fig. 6.

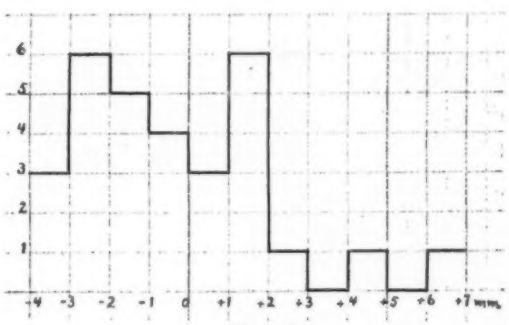

Fig. 7.

Fig. 6.—Deviation of the molar distance from the third of the maximum zygomatic breadth (30 individuals).

Fig. 7.—Deviation of the molar distance from the distance calculated after Pont's method (30 individuals).

for the same period. This discrepancy is only a seeming one and can be easily corrected if we analyze the changes which the relations of the zygomatic bone and, especially, its processus maxillaris undergo in their position to the maxillary dental arch. The processus maxillaris is one of the most important pillars through which the pressure produced by chewing is transferred to the bony base of the head. Therefore, we find the insertion of the processus maxillaris always at that point where the strongest pressure is exercised. After the investigations of *Klaatsch* it had already been ascertained that, in some primitive peoples, the "crista zygomatica alveolaris" inserts into the *distal* root of the maxillary first molar, whereas in cultivated peoples the *medial* root takes this place. But still more interesting and enlightening are the investigations which Bluntschli has devoted to the "zygomatic bone problem." Bluntschli stated that in the infantile skull the insertion of the zygomatic bone is to be found more forward than in later years. During the period of pure deciduous denture, the insertion is above the second deciduous molar and, only after the eruption of the first permanent molar, it wanders backward, to find a standstill above the medial root of the first molar or, sometimes, even above the middle of the molar. If we realize these facts, we can easily imagine that during the period of adolescence we must not try to employ our method mechanically by relating the zygomatic breadth with the distance of the first molars, but we must relate it to the distance of those teeth which stand under the insertion of the zygomatic bone. Therefore the formula of our relation now covering the whole period of adolescence as well as of maturity may be: *The maximum zygomatic breadth is three times the alveolar breadth in the region of the teeth under the insertion of the zygomatic bone.*

I am conscious that this merely scientific statement does not satisfy our desire for a simple and practical numerical relation. But, on the basis of the above reported statements, such a relation is easily established. Table VII shows that the increase of the zygomatic breadth, on the average, is 1.5 mm. annually until the age of twenty years. If we, for example, have to treat a child of ten years and would decide upon the right distance of the maxillary first molars, and the zygomatic breadth is 120 mm., we must not decide upon 120 : 3 = 40 mm., but we have, first of all, to add the expected increase of the zygomatic breadth: 10 times 1.5 mm. It is only from this measure 120 + 15 = 135 (*expected zygomatic breadth*), that we may derive the molar distance: 135 : 3 = 45 mm. By neglecting this necessary supplement, it happened that O. E. Meyer (Basle) who tried to test my method in 100 children, came to negative results. Also the tests of G. Harth, suggested by Korkhaus (Bonn), failed to arrive at correct findings, on account of improper grouping and misleading comparisons.*

A most thorough and comprehensive test was carried out by C. Smyth and M. Young (London), based upon records of measurements of 1,400 children with normal dentures. Among other things, the zygomatic molar relation was also to be examined. I think it is not necessary to give here a detailed report of their findings; yet I cannot but cite the following sentence from the concluding chapter: "Among many interesting associations that are demonstrated

*No. 4 of the references is a detailed answer to those investigations.

by the coefficients is the appreciable and significant association that obtains between the zygomatic breadth of the dental arches, although such a relationship has been denied by Korkhaus, Linder and Harth, Williams and other observers."

In a recent review of these investigations Izard (Paris), who himself has indicated a method utilizing the zygomatic bone, comes once more to the conclusion that "on account of the great number of observations the authors have made and in regard to the exactness of their measurements, it is not possible to deny the reality of certain alveolar-face relations." And he ends, "The correction of the zygomatic breadth as proposed by Berger is excellent and allows in advance to determine the zygomatic breadth at the age of twenty years; I consent to this method without reservation."

I think there is now no further need to add anything on behalf of the zygomatic method, and I have only to indicate how to employ it with regard to "anomalies of combination." The practitioner who is used to the methods of Hawley, Herbst, Pont, at first will determine the breadth of the arch, as usual. Afterward he will compare it with the measure found along the zygomatic method. If there is no great difference between the two measures, he may operate along the usual lines. But, if there are differences, of say 8 or 10 mm. or still more, we must suppose that there is a real "anomaly of combination," and we must think of the possibility of extraction in order to establish a convenient relation between the denture and the too small bony base.

In this way we will, simultaneously, form a denture which does not disturb the physiognomy, but will be convenient for the individual type. I am also certain that, in this manner, relapses will be avoided, which were due to an expansion of the arches which was not an expansion but an overexpansion if we judge by the point of view which I tried to establish.

There is not only the danger of relapses which threatens our work; there is also a danger for bone and roots which was revealed only in recent years (Ketcham, Oppenheim). Since a thoroughly approved extraction may shorten the time of the treatment as well as the extent of the necessary movements, it may, therefore, also lessen these dangers; and I imagine that in these respects, also, this method may be of value for our task. This task—to come to a final conclusion—has up to now been best characterized by Andresen (Oslo) as a "functional and cosmetic optimum."

In line with the contribution here given, I might slightly alter and supplement the term and propose the formulation: *"a static and esthetic maximum by a minimum of treatment."*

These are the two necessities demanded by the science of orthodontia. It remains for the art of the orthodontist to combine them and to weigh them against each other.

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NEUTROCLUSION CASE INVOLVING CONGENITALLY ABSENT TEETH

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THE patient, a girl twelve years of age, was presented for the purpose of improving the esthetics of the maxillary incisors, the principal objection of the parents being a wide diastema between the central incisors. Examination revealed a condition of neutroclusion with $\underline{2|2}$ and $\overline{5|5}$ congenitally absent. The maxillary right side was in linguoversion from $\underline{3|}$ to $\underline{7|}$ with $\underline{5|}$ unerupted and lying horizontally in the palatal. The $\overline{V|V}$ were in position but the roots were nearly resorbed; $\overline{|3}$ was rotated and standing labial to $\underline{|3}$.

History.—The history was that of the average normal healthy child with the exception of the missing teeth. A younger sister also had missing lateral incisors but all her premolars were present.

Etiology.—It is probable that loss of continuity of the approximal contacts due to the missing $\underline{2|2}$ is responsible for the collapse of the maxillary arch as well as for the diastema between the incisors; $\underline{5|}$ was retarded in development and eruption, which allowed $\underline{6|}$ and $\underline{4|}$ to close the space partially. Disharmony of the arches was further increased by the excess width in $\overline{V|V}$.

Prognosis.—It is sometimes advisable in cases which involve missing lateral incisors, to redistribute the spaces without inserting supplies. In this case, however, the collapse of the maxillary arch makes it necessary to restore the space and to insert artificial substitutes.

Some consideration was given to closing the $\overline{V|V}$ spaces, but after the maxillary right section was corrected this too was deemed inadvisable.

Prognosis depends upon the establishment and maintenance of harmonious arch form by supplying the missing teeth and establishing vigorous function and correct cusp relation to prevent collapse of the arch on the right side.

Treatment.—The case was treated in the following manner: $\overline{5|}$ and $\overline{|5}$ were not loose but were so far resorbed that they were extracted before treatment was started. Molar bands and lingual wire were applied to both maxillary and mandibular arches. The maxillary teeth in linguoversion $\underline{7|}$ to $\underline{3|}$ were stepped over one at a time using U-shaped finger-springs, and the diastema between $\underline{1|}$ and $\underline{|1}$ was closed by means of loop springs. The arch was then readapted to the new form, and steel facings were soldered to the wire to maintain the lateral spaces and to improve the esthetics during the remaining treatment. Space for $\underline{5|}$ was opened by means of the loop and a stop to $\underline{4|}$; $\underline{5|}$ was exposed surgically and a pin cemented into the occlusal fissure. It

Presented at the Thirty-Fifth Annual Meeting of the American Society of Orthodontists, Chicago, April, 1937.

Fig. 1.

Fig. 2.

Fig. 1.—Casts before and after treatment.
Fig. 2.—Photographs before and after treatment.

Fig. 3.

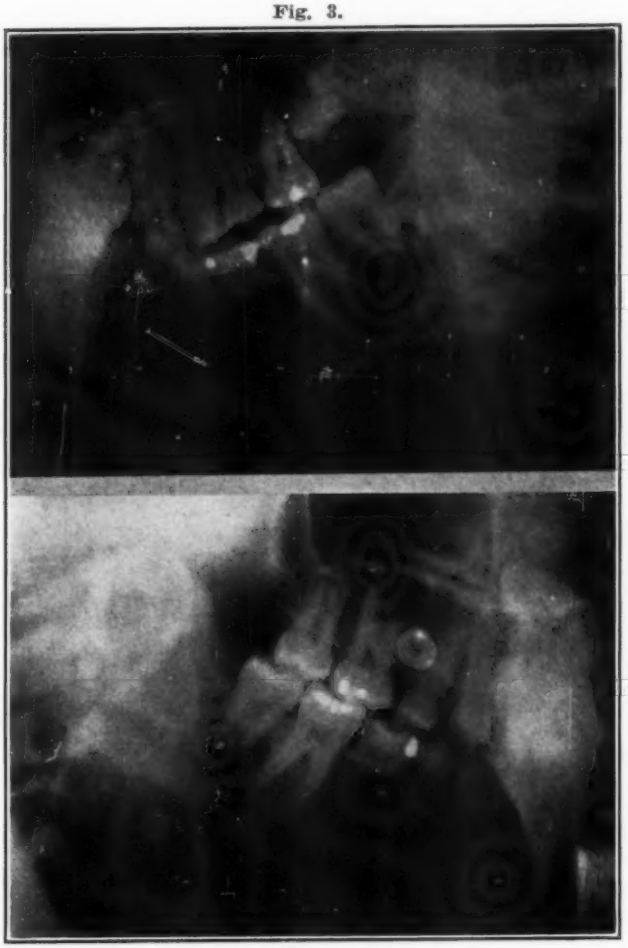

Fig. 4.

Fig. 3.—Showing $\overline{|V}$ root absorption.

Fig. 4.—Showing $\underline{5|}$ horizontal and $\overline{V|}$ with roots absorbed.

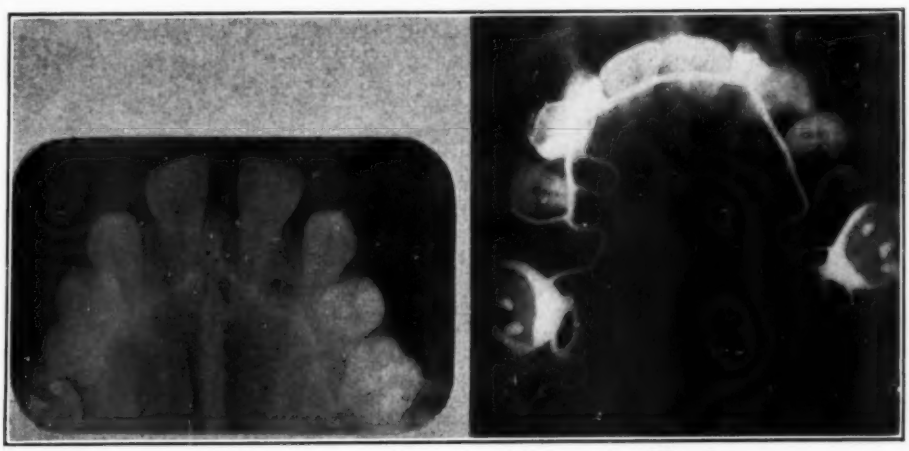

Fig. 5. Fig. 6.

Fig. 5.—Diastema of missing lateral incisors.

Fig. 6.—Appliance after reconstruction: lateral facings; rotation of $\underline{3|}$; unerupted $\underline{5|}$; loop and stop to open space.

was then tipped buccally into alignment by means of a spring. Rotations were done as indicated, and the muscles of mastication were given suitable exercises.

The maxillary arch was retained by means of a $\underline{4|4}$ retainer with the facings attached, and extensions to the $\underline{6|6}$.

The mandibular arch was retained in a similar manner with cast sanitary supplies to retain $\overline{5|5}$ spaces, and furnish occlusion with the maxillary arch.

This case is presented principally to illustrate the several complications from a single etiologic factor and also the simplicity of the appliances used.

60 Charlesgate West

CASE REPORT

EUGENE J. KELLY, D.D.S., TRENTON, N. J.

THIS case presented no unusual difficulties in treatment but has some value in that similar cases may be treated in a relatively short time without undo harm to the patient.

Fig. 1.

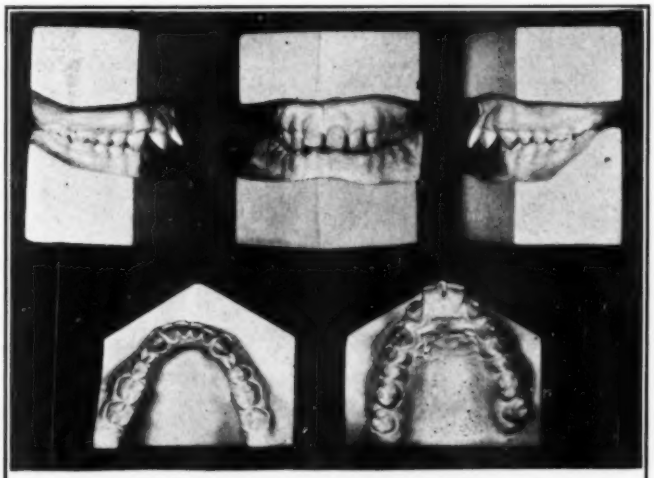

Fig. 2.

Etiology: Young lady seventeen years old; height 5 feet 4 inches; weight 110 pounds; no serious illness other than pneumonia at an early age. Tonsils and adenoids removed at six years. Habits included thumb-sucking and later lip biting. Thumb-sucking habit was broken at about seven years of age. Trace of lip biting was still present when patient applied for treatment.

Presented before the New York Society of Orthodontists, New York City, March 16, 1937.

Classification according to Angle was Class II, Division 1. According to gnathostatics the salient features were: bimaxillary dentoalveolar contraction accompanied by an anterior dental protraction of the maxillary arch in conjunction with a dentoalveolar retraction of the mandibular arch. (Fig. 1.)

Treatment: Tie bracket bands were placed on all the mandibular teeth, with the exception of the molars. Molar bands with edgewise tubes were placed on the first molars. A light round arch wire of ideal shape, size 0.018, was inserted into the mandibular molar tubes and brackets to round out the arch and

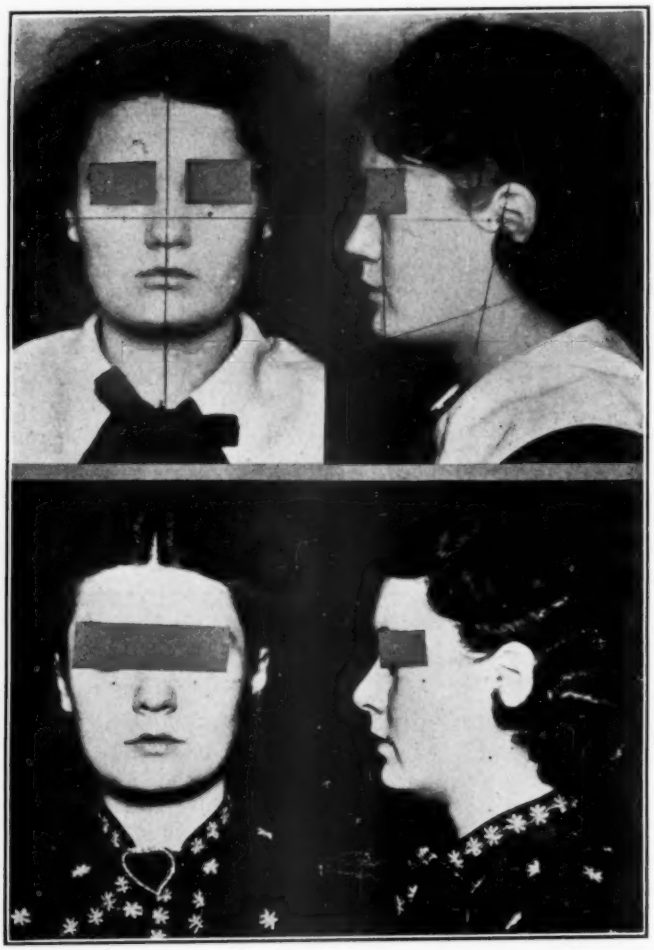

Fig. 3.—Photostatic pictures of the patient before and after treatment. There is some slight difference apparent in the cleft of the chin.

to remove the excessive curve of Spee. Angle speaks of this in his original paper dealing with the edgewise arch as the first order of tooth movement. While this action was taking place, tie bracket bands were also put on all the maxillary teeth except the molars. The molars were banded with the usual type bands having edgewise tubes soldered in place. Here also a light round arch wire size 0.018 and of ideal type was used. However, to this arch wire were soldered intermaxillary hooks, and intermaxillary elastics were immediately used.

At this time the excessive curve of Spee had been practically eliminated; hence no interference was present. The 0.018 arch wire after six weeks' treatment was changed for one of 0.022. After the maxillary teeth were in position,

an edgewise arch wire size 0.022 × 0.028 was used. Intermaxillary force was still used. Fig. 2 shows the case after nine months of treatment.

It was my belief at this time that while an apparent deep overbite existed it was due to a lack of vertical growth in the premolar and molar regions. Also the interdigitation of the cusps was not ideal, but inasmuch as a Hawley retainer with a small inclined plane would allow vertical growth to take place and promote a better cuspal function, active treatment was terminated. Time verified this belief, and just last week I saw the young lady. The overbite is normal, as is the relationship of the opposing teeth.

Fig. 4.—X-ray pictures before treatment.

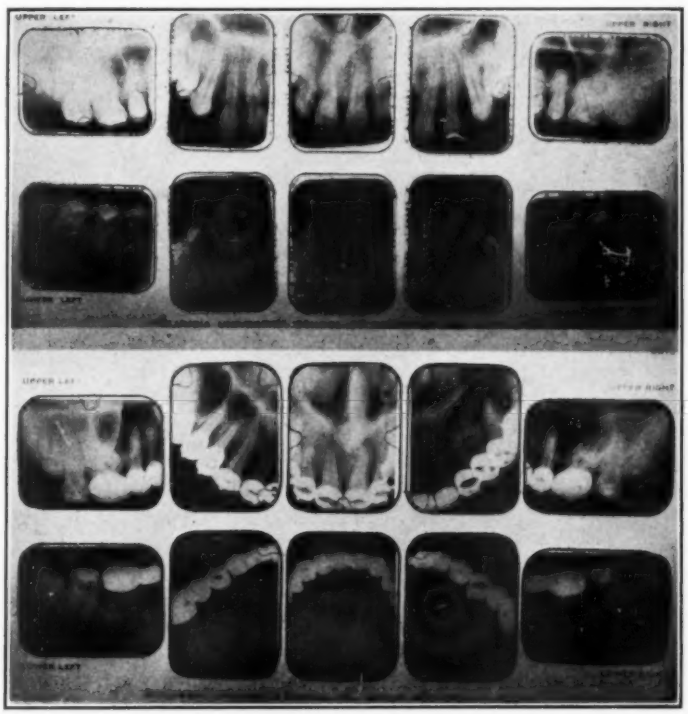

Fig. 5.—X-ray pictures after treatment.

From the models you would no doubt believe the patient would present a homely appearance before treatment and that the improvement in facial harmony would be comparable with the improvement in the arches. Such, however, is not the case as you may well judge from the photographs made before and after treatment (Fig. 3).

To some of you the question of root resorption has no doubt occurred. The amount of tooth movement obtained in such a short period of time can often be alarming. I knew in this case that we were dealing with a hypoplastic type of bone, and I checked the roots frequently with radiographs. Fig. 4 shows the radiographs taken before treatment, and Fig. 5 shows those taken the day the appliances were removed.

Some resorption has taken place, particularly on the roots of the anterior maxillary teeth but whether or not this is in any way injurious to the dental health or general well-being of this young lady I leave to your judgment.

AN EXERCISE TO RESTORE NORMAL LIP FUNCTION

A. J. La Grow, D.D.S., Oak Park, Ill.

VARIOUS lip exercises have been given patients by orthodontists to improve the tone of the lips with various results. It is the overactive lower lip and the hypertoned mentalis muscles, however, that are most baffling of correction. Patients with a short hypotoned upper lip will, when asked to close the lips, contract the mentalis muscles, as well as the caninus muscles. The upper lip, in this type of patient, takes very little part in the act of closing. The upper

Fig. 1. Fig. 2.

lip, therefore, does not become developed, and there is a loss of normal pressure on the maxillary incisors. Even more harmful than this is the abnormal pressure of the mentalis muscles on the mandibular incisors and cuspids. Although the mentalis muscles are not inserted into the orbicularis oris, they push the lower lip up, in this type of individual. The right and left caninus muscles, acting together, normally lift the lower lip. The maxillary incisors, in some cases, are tilted forward by the action of the lower lip aided by the mentalis muscles.

I have used several different lip exercises in my practice, but the exercise I am here describing, I believe, fulfills all the requirements. These requirements are (1) to lengthen the upper lip, (2) to restore tone and function to the lips, (3) to bring about a normal closure of the lips in which the mentalis muscles

Clinic presented at the Thirty-Fifth Annual Meeting of the American Society of Orthodontists, Chicago, April, 1937.

do not take part, (4) to produce a relaxed condition of the mentalis muscles. I call this exercise the depressor lip exercise because it is these muscles which are activated in this exercise. They are the right and left triangularis and the right and left quadratus labii inferioris. The triangularis draws the upper lip down and the quadratus labii inferioris draws the lower lip down. To perform the exercise, the lips are closed and the depressor muscles are contracted. This brings both lips downward together. The orbicularis oris is exercised at the same time. The mentalis muscles are compelled to inactivity during the time this exercise is being done and are overpowered. When this exercise is carried out with regularity, the lips finally close normally without any abnormal activity of the mentalis. It is highly important, however, for the orthodontist thor-

Fig. 3. Fig. 4. Fig. 5.

oughly to understand this exercise before attempting to teach it to a patient. In Fig. 5 please note that the mentalis region is smooth, indicating that these muscles are not contracting. The teeth should be closed because, in most individuals, the platysma muscles contract at the same time, which has a tendency to pull the mandible backward.

Figs. 1 and 2 are photographs of a patient who presented with a short upper lip which did not function. The face of the same patient is shown in Figs. 3 and 4 three years later. The improvement in the facial lines was brought about by an improvement in the occlusion, an improvement in the length of the upper lip, an improvement in the tone and function of the lips, and by a more relaxed condition of the mentalis muscles. Fig. 5 shows the patient performing the exercise.

THE ORTHODONTIC CAST BAND

RALPH BERKSON, B.S., D.D.S., CHAMPAIGN, ILL.

CAST overlays have been frequently used by some orthodontists in places in which a regulation band could not be used, but there has been no general routine use of cast bands. A cast band fits far more accurately than one made of a strip, ferrule or clamp; it may be contoured similar to other bands and cover the crown surface as extensively. The cast band, however, is rigid and cannot be distorted very much in being pushed down on the tooth crown. For this reason, its use is limited chiefly to the molar teeth. On these teeth, both permanent and deciduous, cast bands can be used routinely—their stability, retention and comfort far surpassing those made by other methods.

Even when well made, the regulation molar band occasionally loosens or splits, especially with patients who tamper with their appliances, and when placed on deciduous molars. The retentive properties of a cast band are so great that the problem of loosening never arises; and if it is properly designed, the cast band will never split. The fit of cast bands is so accurate that there is no danger of cement disintegration under them.

In designing any band, other than a clamp band, it is well to remember that if the gingival border of the band extends beyond the greatest circumference of the crown, it cannot be in surface contact with the tooth gingival to this plane of greatest circumference. Contrary to popular opinion, the greatest circumference of a tooth crown is not at the contact points. The location of the plane varies with each tooth, but is fairly definite in teeth of the same character. On the molar teeth the plane of greatest circumference is near the gingival line. This plane is well under the free margin of the gum in most children and adolescents—permitting the gingival border of the band to fit tightly against the tooth crown under the gum margin.

The impression for a band needs to include only the tooth to be banded and the crest of the gingiva surrounding the tooth. There are several satisfactory materials and methods that can be used to obtain the impression. If separating wires have been placed, an oversized, thin, annealed copper tube can be used as a tray—filled with modelling compound or elastic material. Separating wires should be replaced after taking the impression. A sharp, accurate impression is all-important in any indirect technique.

The impression is poured with casting investment, preferably a smooth, hard type such as model crystobalite. The model is carved in the usual manner, the gingival portion extending slightly below the gum margin, and the proximal surfaces *convergent* below the contact points. If good separation has been obtained and elastic material used for the impression, the undercuts below the contact points will be reproduced in the model. This will eliminate some guesswork in the carving.

The occlusal and gingival borders of the band are drawn around the model with a pencil, showing the exact festooning and position desired. The occlusal border of the band should be kept out of occlusion with opposing teeth as much as possible. The model is then cut down to these lines. This leaves only a model of the crown portion which is to be covered by the band.

A strip of sheet wax is adapted to the model, and the gingival and occlusal edges of the wax are fused to the model. For simple types of casting equipment use 28 gauge wax; 30 gauge wax can be used with the better types. Place a drop of hard inlay wax where the sprue-former is to be attached (generally on the proximal); this will provide a rigid attachment. Use a short, heavy wire for the sprue-former, at least 11 gauge. On the opposite side, attach an eighth-inch length of round wax to form a vent in the mold. This will aid later in the casting. Invest in an inlay ring with a porous investment material. (Several bands can be invested in one ring.)

Fig. 1. Fig. 2. Fig. 3.

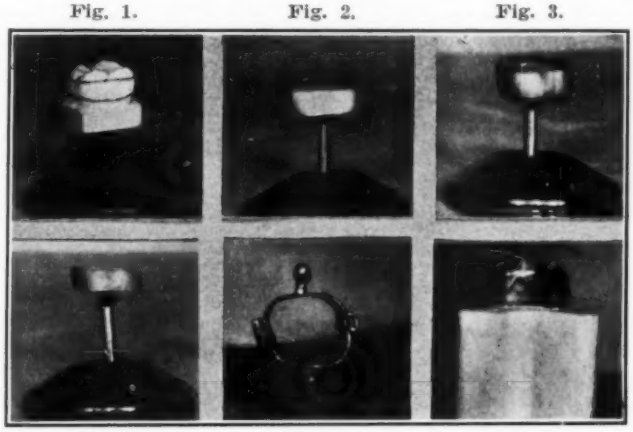

Fig. 4. Fig. 5. Fig. 6.

Fig. 1.—Model carved and lines drawn representing extent of band.
Fig. 2.—Model cut down to lines.
Fig. 3.—Wax adapted to model.
Fig. 4.—Occlusal and gingival borders of wax trimmed and fused to model.
Fig. 5.—Band cast directly to buccal and lingual tubes. Notice the short, heavy sprue and vent opposite.
Fig. 6.—Plain cast band before soldering on attachments. Notice the notch at the mesiobuccal surface angle.

It is necessary to follow a high heat technique in casting and to heat the gold well above its fusing point so it will flow completely into the thin mold. The vent opposite the sprue decreases air resistance and thus aids in filling the mold completely. Cast with a hard gold alloy.

The proximal areas of a band thus cast will be too heavy and must be disked down to proper thickness. First remove any nodules of gold that may be found inside the band or on the occlusal and gingival borders. With a jeweler's thin blade, saw off the sprue and vent. A Boley gauge is a good instrument to use in determining thicknesses. Reduce the proximal areas to 0.007 inch. At this thickness the band is sufficiently strong. Feather edge the gingival border and polish.

Occasionally severe undercuts are present at the buccoproximal surface angles. When these are encountered, a V-shaped notch can be cut in the band to allow for its correct seating. The narrowed portion occlusal to the notch

should be left rather thick to compensate the loss of strength by narrowing the band in this area. Such a notch is in a caries immune area of the tooth crown and if broad will be self-cleansing. On bell-shaped crowns, the gingival portion of the band may be eliminated on both the buccal and the lingual areas. When wide areas of the tooth crown are left exposed, they are easily cleaned and there is no danger of decay. The contour and area extent of a cast band can be varied in many ways to satisfy the conditions present. The band can be made as narrow as a prosthetic clasp in certain areas. When varying the contour, keep in mind that narrow portions can be made stronger by an increase in thickness.

For banding purposes, the new chromium-cobalt-tungsten alloys are superior to gold. They can safely be reduced to 0.004 inch in thickness, take a brilliant polish, and attachments are easily soldered to them. However, elaborate equipment is required to cast these alloys. The cost of having them cast in commercial laboratories is rather high but not prohibitive.

Thin, circular bands are more difficult to cast than the usual dental pieces. Accuracy of fit depends upon the impression and successful casting upon a short, heavy sprue, vent, red-hot mold, and metal heated to a degree where it will flow easily. Overexpansion or contraction of the investment might possibly result in a casting that cannot be used. This factor, however, does not seem to require so much attention as it does in other dental castings. Those unfamiliar with casting techniques will find it desirable to pour the impression with model stone and obtain casting investment reproductions with elastic impression material. It is quite likely that failures in getting the gold to completely fill the mold will attend the first few attempts at band casting. Having a durable model will eliminate the necessity of recalling the patient for second impressions.

As cast bands are difficult to remove, even when not cemented, it is a good plan to provide a catch on the band for the band removing instrument. Several soldering operations may be eliminated by waxing on attachments (tubes, brackets, lugs, etc.) before final investment. Such attachments should be covered with high karat solder at the point of union with the band.

After becoming familiar with the technique, bands made in this manner do not require much more time than those made by other methods. The assurance of placing a band that fulfills all its requirements much better, and at the same time is economical, more than justifies the extra laboratory time.

Orthodontic castings are not limited to bands. The method can be used to advantage in many cases of appliance construction. Modern dental castings are extremely accurate; and, within limits, the physical properties of a casting can be controlled, by the choice of alloy, to fulfill various requirements. A review of the literature shows that orthodontists have given but slight attention to casting. I do not wish to minimize the importance of rolled and drawn metals but rather to suggest that casting deserves a place in every orthodontist's laboratory. A general interest in the subject would undoubtedly bring forth fresh ideas in appliance construction to better control anchorage, movement, and retention of teeth.

ROBESON BUILDING

A CONTINUOUS RECIPROCAL AUXILIARY SPRING

For Expansion of the Lateral Segments and Forward Movement of the Anterior Segment

L. B. Higley, D.D.S., Iowa City, Iowa

THE continuous reciprocal auxiliary spring has been evolved through the use of the single wrapped spring. The continuous reciprocal type for the mandibular arch may be divided into an anterior and two lateral segments. It is soldered, wrapped and contoured with respect to the lingual arch wire as follows*:

a. The spring consists of an 0.016 inch wire soldered to the occlusal aspect of the 0.040 inch arch wire distal to the left second bicuspid.

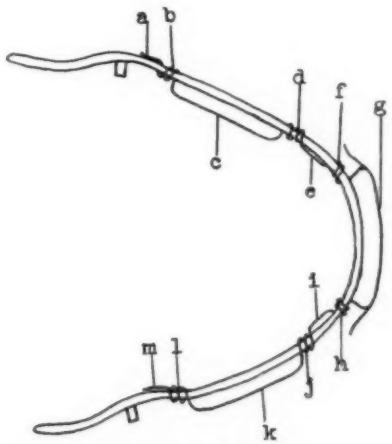

Fig. 1.—Occlusal view from the right of the mandibular arch wire with a continuous reciprocal auxiliary spring.

b. Immediately in front of the solder joint the 0.016 inch wire is wrapped around the 0.040 inch wire in a clockwise manner (buccally) two or three times.

c. It is now carried gingivally, then mesially to rest against the bicuspids and to lie to the buccal between the 0.040 inch wire and the teeth and just free of the gingival tissue.

d. Mesial to the first bicuspid it is carried occlusally, then wrapped in a counterclockwise direction around the 0.040 inch wire several times, stopping the wrap on the gingival aspect of the main wire.

e. Then carried along the 0.040 inch wire to the mesial of the cuspid.

f. Now wrapped several times again in a counterclockwise direction.

From the College of Dentistry, State University of Iowa.

*All the letters in this description refer to the illustrative Fig. 1.

g. Then carried incisally, then across the lingual of the four anterior teeth just above the junction of the middle and gingival thirds, and then gingivally to the arch wire just distal of the right lateral incisor.

h. Now wrapped several times in a clockwise direction.

i. Then carried along the gingival aspect of the 0.040 inch wire to the distal of the right cuspid.

j. Now wrapped several times in a clockwise direction.

k. Then carried gingivally between the teeth and the arch wire, then distally to rest against the right bicuspids just above the gingiva. Then carried occlusally just distal to the right second bicuspid.

l. Now wrapped several times in a counterclockwise direction.

m. Finish by soldering to the occlusal aspect of the 0.040 inch wire.

It will be noted that only two solder joints are used, both of which are located at the distal extremities of the 0.016 inch spring wire. Because of this and the method of wrapping the wire the lateral and anterior segments become reciprocal in action, since compression of the lateral segments throws the anterior segment forward and compression of the anterior segment throws the lateral segments buccally.

The anterior segment may be made to include the four incisors only with small segments of the same gauge wire soldered to the spring to contact the cuspids, or this segment may be so contoured as to include all six anterior teeth.

If the bicuspids of only one side need to be carried buccally and the anterior teeth labially, the reciprocal advantage may be preserved by using the anterior segment and the one lateral segment. Any segment may be used singly, but no reciprocal action occurs. These are of advantage when local action rather than for generalized expansion.

These springs are of especial value where the bicuspids are short or where considerable curve is found in the mandibular arch. Since there are no free ends, they are not displaced nor do they imbed themselves into the gingival tissue.

They find a place in the maxillary arch as well, especially single anterior segments for the maxillary incisors where the ordinary spring has a tendency to crawl incisally. Frequently a short spring of this wrapped type may be used for a single tooth and is of especial value for moving maxillary cuspids.

The wrapping is always made in such a manner that the spring will tend to unwrap against the tooth or teeth in the direction the force is to be exerted.

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FRACTURES OF THE JAWS

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A REVIEW of the literature on fracture of the facial bones indicates an increasing tendency to injury particularly of the mandible. The other bones commonly involved in the order of frequency are the maxillary, nasal and malar. This inclination to injury may be attributed primarily to their position of prominence which renders them susceptible to trauma of various kinds. The purpose of this paper is to consider the basic principles of treatment of jaw fractures, to point out effective means of reduction and to emphasize the necessity of correct control of complications—essentials which are vital to the restoration of the normal function of the jaws and the proper contour of the face.

PRINCIPLES OF TREATMENT

Provided other bodily injuries of a more serious nature are not present, reduction and fixation should be instituted as soon as feasible. Needless delay has a tendency to increase the inflammatory reaction and consequently the possibility of complications. Every effort should be made to eliminate those conditions which might aid or cause infection. Since the mouth offers a favorable medium for bacterial growth, special prophylactic measures should be employed. Brushing the teeth, cleansing the immobilization appliances, and irrigating the oral cavity are important factors in avoiding sepsis.

The removal of diseased roots and the eradication of gingival infection are most desirable. Because retaining a tooth in the line of fracture often results in a localized osteomyelitis, early removal is advocated except in certain fractures at the angle of the mandible. In these cases the retention of a tooth in the posterior fragment for a short period of time assists in maintaining the parts in good position until fibrous union has taken place.

The management of fractures of the jaws is a mechanical problem of a dental nature. It therefore follows that those who treat this type of bone injury should be familiar with the proper concept of the maxillary and mandibular relationship of the teeth, the attachment and pull of the various muscles, and

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the importance of mastication to general bodily health. In the majority of cases it will be found that the best clinical results are obtained when the intraoral application of wires, metal bands and elastics is accurately carried out. Alignment of the fractured parts should always be made with a view to restoring the former occlusion of the teeth. This principle is so basic as to apply in the case of all fractures; failure to utilize this fundamental idea leads invariably to malunion with deformity of the jaw, impairment of the masticating function and poor cosmetic results.

THE MAXILLA

Consideration of the anatomic construction of the upper jaw reveals to a large extent the reason that different areas exhibit varying degrees of vulnerability. The maxillae comprise by their union the whole of the upper jaw. Each assists in forming the boundary of three cavities, viz., the roof of the mouth, the

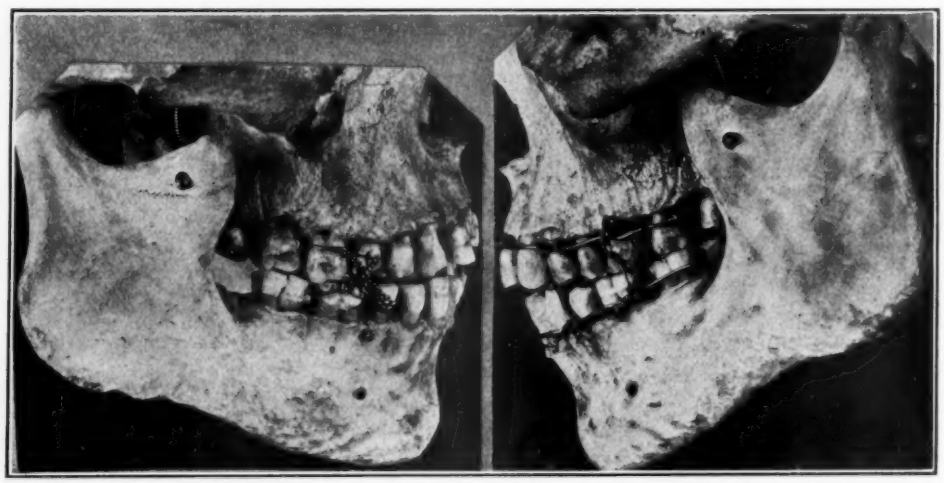

Fig. 1. Fig. 2.

Fig. 1.—Gilmer No. 1 method of wiring. Single wires attached to maxillary teeth and then twisted with wires similarly placed about occluding teeth.

Fig. 2.—Gilmer No. 2 method. Metal bar adapted to labial aspect of maxillary and mandibular teeth. Fine intermaxillary tie wires used to bring about reduction.

floor and lateral wall of the nose and the floor of the orbit.[1] The body of each bone contains the antrum of Highmore, a large pyramidal cavity, the apex of which directed lateralward, is formed by the zygomatic process. The upper jaw is well supported above by the frontal bone, posteriorly by the sphenoid, and laterally through the zygomatic arches by the temporals. Blows travelling from in front encounter posterior support and are fairly well sustained. However, force directed from above downward or from below upward tends to detach the whole jaw from its weak connection with the base of the skull.

Fractures of the maxilla may be classified as partial or complete. Because of the frail osseous nature of the upper jaw, extensive comminution often results. The fracture line may be located just above the alveolar process, higher up through the body of the bone, or may even extend across both orbits. Partial fractures may evidence little change from normal position; on the other hand, complete transverse fractures usually result in a downward and sometimes a

backward displacement. The diagnosis depends primarily on careful clinical examination. The roentgenogram, because of the tendency of overlapping of the shadows of the cranial bones, cannot be very well relied upon as an aid in determining the lines of fracture. The symptoms to be observed are: (1) altered facial contour, (2) malocclusion of the teeth, (3) mobility of the bony framework.

Returning and retaining the fractured parts in proper position with the normal occlusion of the teeth as a guide should always be the aim in treatment. Fractured pieces of bone with mucous membrane attachment should under no circumstances be removed, as a loss of any osseous tissue might result in deformity. The rich vascular supply of the maxilla, particularly from the internal maxillary artery, tends to encourage early and rapid healing. Therefore, it is most essential that, if facial distortion difficult of correction is to be avoided, reduction should be carried out as soon as is practicable.

Partial fractures may be reduced and immobilized by any one of the several methods which will be considered later. Treatment of complete fracture neces-

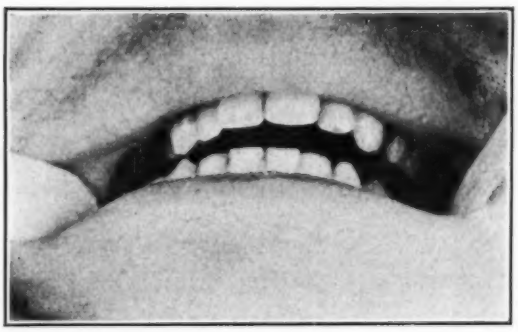

Fig. 3.—Malocclusion of teeth characteristic of fractures of the jaws.

sitates going outside the mouth for support and the use of more extensive appliances in order to hold the maxillae in place. An efficient method of immobilization is as follows: first, a metal tray containing softened impression compound is forced up and around the teeth of the maxillary arch; then, metal arms previously soldered to the sides of the tray and fashioned to extend from the corners of the mouth are attached to a headcap by means of an elastic bandage. Normal occlusion is gauged by forcing the mandible into place against the fractured maxilla. The traction exerted by the elastic bandage tends to hold the fractured jaw in position.

METHODS OF IMMOBILIZATION

Intraoral methods of fixation may be divided into two general classifications applicable to: (1) those cases of fracture in which there exists a sufficient number of teeth suitable for anchorage purposes; (2) fractures of edentulous jaws. In a paper[2] read during the recent Congress of the American College of Surgeons, I described effective methods of immobilizing fractures of the edentulous mandible. Therefore, present consideration will be given only to the first group which constitute by far the majority of cases. Gradually simpler and more

efficacious wiring methods are replacing the time-consuming practices of the past. Except in the unusual case, it is no longer necessary to postpone reduction because of the delay incurred in the construction of complicated splints. Moreover, splints interfere with visual examination of the occlusion, the restoration and maintenance of which are cardinal principles in the treatment of this type of bone injury. Gilmer's basic methods[3] of fixation have simplified the problem of immobilization and have laid the foundation for the modified procedures followed at the present time. His first method consisted of passing single wires around adjoining maxillary teeth, making a strand of each wire and after crisscrossing, twisting them with wires similarly attached about the occluding teeth of the mandible. This method is most useful when each jaw contains a great number of teeth. In his second method an expansion arch was attached to the labial and buccal surfaces of the teeth of both the maxilla and the mandible and then connected by fine intermaxillary tie wires. This type of wiring had two advantages over the first and older method. Opening of the jaws, if necessary at

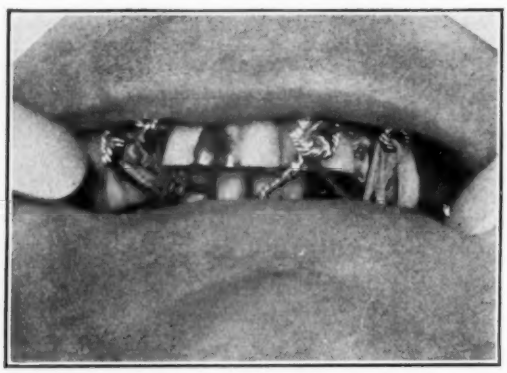

Fig. 4.—Bilateral fracture of the mandible. Reduction by means of intermaxillary wiring.

any time during the period of immobilization, did not disturb the fixation appliances, and, second, earlier mobility of the mandible was permissible because the arch served the same purpose as a firm splint. The Ivy eyelet method,[4] which is both simple and efficient, is extensively used today. This method also allows free access to the oral cavity. Moreover, if the occluding wires should have to be severed, replacement can be made with very little difficulty and inconvenience.

THE MANDIBLE

The mandible is an irregular bone to which are attached many muscles exerting traction in various directions. Fracture is usually the result of direct trauma. It can be easily seen from the antagonistic group of muscles why injury of this bone would be accompanied most often by displacement. In fractures at the angle, unless precluded by the direction of the fracture line, there is a tendency for the lower end of the ramus to be pulled upward by the masseter and the internal pterygoid musculature. The mylohyoid and other muscles attached to the internal surface of the body of the jaw produce downward displacement.

Fracture of the mandible is usually characterized by tenderness at the site of injury and difficulty in swallowing. Anesthesia of the lower lip is a frequent though not a constant accompaniment. Attempts to elicit crepitus, because of the unnecessary pain and discomfort resulting, are not advisable. The x-ray furnishes the easiest and most definite means of locating the site of injury. Since no part of the jaw can be considered immune to fracture, the importance of a complete roentgenographic survey is quite evident. When only two lateral jaw x-ray pictures are taken, there always exists the possibility that fractures of the condyle and symphysis will be overlooked.

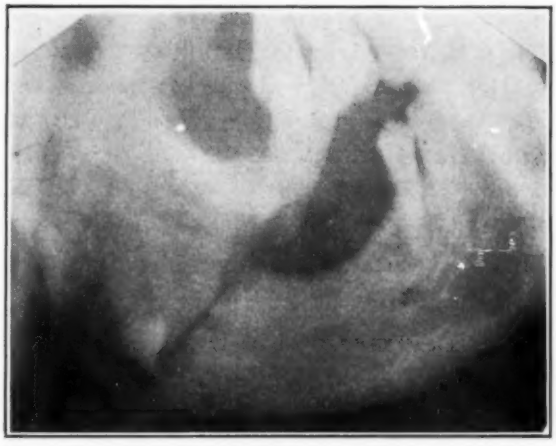

Fig. 5.—Fracture at angle of mandible with elevation of posterior fragment.

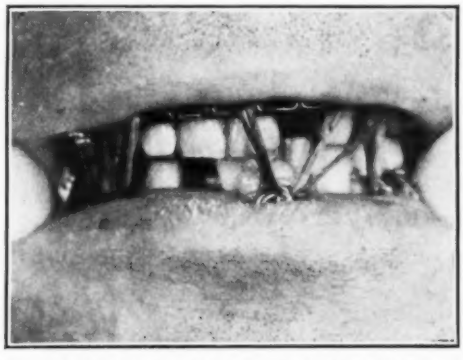

Fig. 6.—Immobilization accomplished by utilizing modified Gilmer splint and elastic traction. Same case as shown in Fig. 5.

The commonest location of single fracture is at the angle of the jaw; the next most frequently injured area is in the region of the mental foramen. When the chin is subjected to trauma, fracture of the symphysis often follows. The ramus may be the site of closed fractures. Fractures in the area from the sigmoid notch to the lower border of the ramus usually exhibit little displacement. When the injury involves either the coronoid or the condyloid process, displacement invariably is present. The former is pulled upward by the temporal muscle, while the latter may be drawn forward in a rotated position by the internal pterygoid muscle.

Although accurate reduction is most often to be sought, exact alignment of the fragments is sometimes not only difficult of accomplishment, but really un-

necessary. In a case of fracture occurring posterior to the last existing tooth (if a second or third molar), slight tendency of the ramus to tilt upward may be disregarded provided the teeth of both the mandible and the maxilla occlude properly. Likewise, displaced coronoid or condyloid processes need no correction if the occlusion is carefully maintained. In these, as in all cases of fracture, the aim is to obtain proper function of the jaws. It would seem superfluous to emphasize the need of maintaining good hygiene of the oral cavity. It can be said that the patient's attention to this necessity has a direct bearing on the end-result.

COMPLICATIONS

Hemorrhage as a complicating factor in a jaw fracture is, as a rule, not severe and can ordinarily be controlled through pressure and the reduction of the fracture. The commonest complication is osteomyelitis. Those cases of cellulitis with suppuration should be incised and ample drainage established. Frequently it is necessary to incise both the intraoral and the external tissues. In this way, an avenue for the escape of pus having been created, infection of the bone will less likely occur. Removal of sequestra is indicated only when the dead bone has definitely been isolated. Delayed union is generally due to osteomyelitis or the existence of fibrous tissue within the fracture line. In persistent delayed union some thought should be given to the presence of such diseases as syphilis and diabetes. Non-union is rare. On the other hand, malunion is not uncommon; it occurs mainly as a result of improper treatment. If reduction with a fair occlusion of the teeth cannot be obtained, the refracturing of the mandible may be necessary.

The management of fractures of the jaws is based on definite fundamentals, correct application of which will restore the parts to their former anatomic normal. When the cardinal principles of treatment are adhered to, established methods of immobilization employed and complications properly controlled, the problem of fractures of the jaws becomes less difficult for the surgeon and results in greater satisfaction to the patient.

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PRINCIPAL FACTORS CONTROLLING DEVELOPMENT OF MANDIBLE AND MAXILLA*

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AS LONG ago as 1868 Darwin conducted experiments to show the effect of muscular activity on the growth of bone. He demonstrated that disuse of the ears in rabbits affected almost every suture in the skull. Marked asymmetry of the skull and jaws was also observed in half lop-eared animals. Later Walkhoff (1903) removed a portion of the left temporal muscle in dogs, discontinuing the attachment to the coronoid process. This resulted in asymmetry of the cranium, and also in a bending of the snout to the left.

Baker (1911 and 1922) undertook experiments to prove that occlusal force, which he believed to be the fulcrum of muscular activity, is the main influence promoting development of the jaws, and bones of the skull. He experimented with various animals, interfering with occlusal force by grinding the teeth or by removing the teeth on one side. This resulted in greater bone development on the side where the teeth were normal. Landsberger (1911) produced independently similar results; but, while Baker believed disturbance of the occlusion to be the main cause of the underdevelopment of the jaws, Landsberger blamed the loss of the teeth. Chapman (1936), on the other hand, concludes that there is no evidence that the teeth have any influence on jaw development, and Cieszyński (1935) goes one step further claiming that the teeth not only do not influence the development of the bone (entire jaw, not alveolar process), but that they themselves are dependent for their size and shape on muscle function.

It seems therefore that by animal experimentation three theories have been developed regarding factors which augment inherent growth tendencies. These may be summarized as follows:

(1) The development of the jaws is due principally to occlusal force during mastication.

(2) The development of the jaws is governed principally by the development of the teeth.

(3) The development of the jaws is fostered principally by muscle activity.

Clinical investigations of certain conditions in man brought about by disease lend themselves to the study of this problem, and are herewith presented with the hope that they may throw additional light on these theories.

*From the Department of Oral Pathology, Harvard University.

PSEUDO-ANODONTIA

Cases of retention of the entire set of teeth present, on examination, an edentulous mouth. The roentgen picture, however, discloses that the teeth have developed but are lying unerupted in the bone. A case of pseudo-anodontia was discovered by Ivy (1933). The patient was twenty-eight years of age and dwarfish in stature. All teeth had developed but none erupted as shown in the roentgen picture, Fig. 1. Dr. Ivy in a personal communication stated

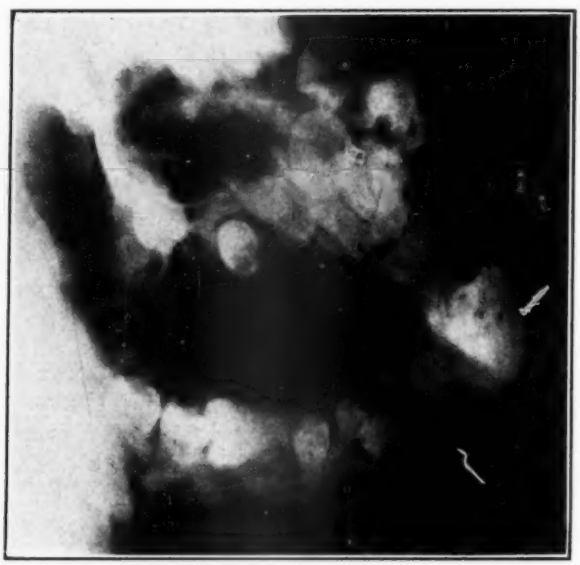

Fig. 1.—Roentgen picture of Dr. Ivy's case showing all permanent teeth unerupted. No underdevelopment of the jaw.

TABLE I

CASE REPORTED BY	TOOTH DEVELOPMENT, MAXILLA	TOOTH DEVELOPMENT, MANDIBLE	DEVELOPMENT OF MAXILLA	DEVELOPMENT OF MANDIBLE	NASAL CONDITION
Guildford	Complete anodontia	Complete anodontia	Underdevelopment. No alveolar process	Normal except for alveolar process	Saddle nose
Nager (Fig. 3)	Complete anodontia	Complete anodontia	Underdevelopment. No alveolar process	Normal except for alveolar process	Saddle nose with ozena
Rushton	Complete anodontia	Complete anodontia	Underdevelopment. No alveolar process	Normal except for alveolar process	Saddle nose
Kuhlo (Fig. 4)	2 anterior deciduous teeth 3 anterior permanent teeth	Complete anodontia	Normal development of alveolar process around 3 teeth	Normal except for alveolar process	Normal nose
Battersby (Fig. 5)	Complete anodontia	Complete anodontia	Normal except for alveolar process	Normal except for alveolar process	Normal nose
Forsyth Dental Infirmary (Fig. 6)	Complete anodontia	Complete anodontia	Normal except for alveolar ridge	Normal except for alveolar ridge	Normal nose

that there was no visible evidence of underdevelopment of the jaws. In this patient occlusal force was absent; therefore normal development of the jaws was due either to the development of the teeth or to muscle function.

ANODONTIA

In anodontia no deciduous or permanent teeth are formed. A number of cases are on record. A few are listed in Table I.

The study of these cases shows that the mandible may develop to normal length without the formation or eruption of teeth. The alveolar process is absent, however, as it forms only when teeth erupt (Fig. 2). With artificial dentures replacing the missing teeth and undeveloped alveolus, the senile effect caused by the closing together of the jaws disappears and the appearance of the profile takes on normal proportions, showing that the mandible has developed proportionately in length even though no teeth are present. This is shown well in Fig. 3.

Fig. 2.—Case of anodontia of Battersby. X-ray picture shows development of mandible normal except for alveolar process which has not developed.

In cases of anodontia therefore where there is no tooth development or application of occlusal force, muscular function and its associated increased blood supply undoubtedly must be the important stimulating factor in the development of the mandible. If muscle function governs the growth of the mandible, it would be natural to expect the growth to be most pronounced where the force is applied, which is at the angle of the jaw. That this is actually the case was demonstrated by experiments carried out on dogs by Proell and Wyrwoll (1934). They showed by placing steel pins into the bone of growing animals that there is no interstitial growth, and that the mandible develops principally in a distal direction in the posterior part of the ramus. The experiments also showed that there is no growth in the third molar region, and that development of the third molar does not create space for its eruption. This can be demonstrated in serial x-ray pictures, taken at intervals. Such roentgen studies show no increase in space between the distal surface of the second molar and the anterior border of the ramus. An extreme case showing a very crowded condition with insufficient room for the second and third molars is shown in

Figs. 7 and 8. In this case the bone development in two years was not sufficient to make room for the complete eruption of even the second molars in the mandible.

In the maxilla the effect of direct muscular activity is small, and other factors must assume the principal rôle in development. It is interesting to note

Fig. 3.

Fig. 4.

Fig. 3.—Case of complete anodontia. Patient wearing dentures shows normal development of mandible and underdevelopment of maxilla with saddle nose. Age twenty-four years. (Courtesy of Prof. Nager.)

Fig. 4.—Case of partial maxillary and complete mandibular anodontia, showing well-developed profile. Age fifteen years. (Courtesy Dr. Kuhlo.)

Fig. 5.

Fig. 6.

Fig. 5.—Case of complete anodontia with normal development of both jaws. Age nine years. (Courtesy Battersby.)

Fig. 6.—Case of complete anodontia. Age six years. Well-developed profile. (Courtesy Forsyth Dental Infirmary.)

that out of the six anodontia cases tabulated three had definitely underdeveloped maxilla (Fig. 3). The facial muscles attached to the maxilla apparently are of minor consideration. They certainly would have functioned equally in all six cases, and the underdevelopment of the maxilla in the three cases with recession cannot be explained from the point of view of muscular function.

By studying patients with ankylosis of long standing (see below) we shall again see that it is not the muscles which control the development of the maxillary bone, because in spite of marked underdevelopment of the mandible in such cases the maxilla attains normal size. In case of the maxilla we must therefore look for another major influence as the dominating factor in its development.

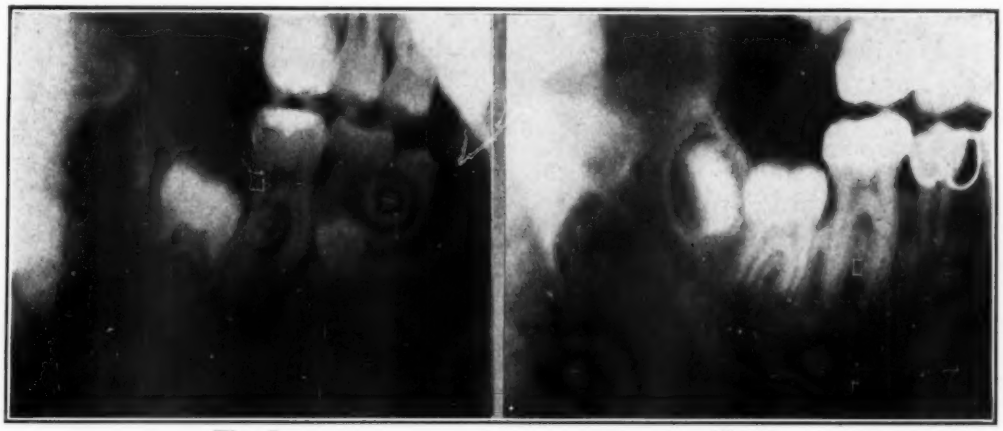

Fig. 7. Fig. 8.

Fig. 7.—Roentgen film of patient, aged eleven. There is insufficient bone development in the molar region. (Courtesy Dr. Blumenthal.)

Fig. 8.—Roentgen film of same patient as Fig. 7, taken two years later, age thirteen, showing that bone development has not progressed sufficiently to allow eruption of the second, and especially the third molar.

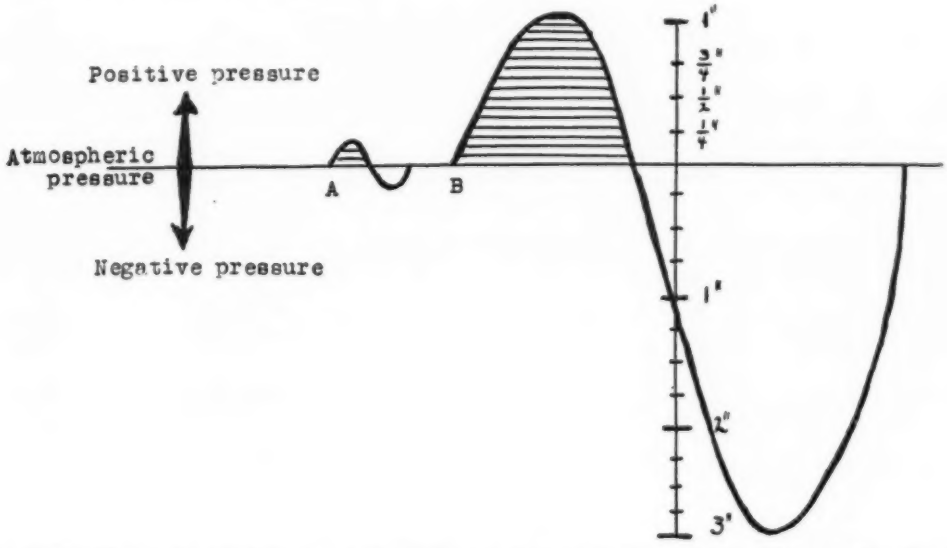

Fig. 9.—Positive and negative nasal air pressure in nose and mouth breathing, after Leader (see text).

Such a factor certainly has been observed by orthodontists and rhinologists for a considerable length of time. I refer to the effect of nose breathing on the expansion of the nasal passage and of the pneumatic sinuses of the face. Wright (1912) described an instrument with which changes in the nasal fossa can be measured in order to compare the development of the nose and that

of the maxillary arch. Leader (1934) undertook experiments to register the effect of respiratory air pressure on the naso-oral cavity. He found that, through contraction and expansion of the chest, air becomes rarefied or compressed in the lungs, which produces its flow through the respiratory passages. He measured the positive and negative air pressure in both nose and mouth-breathing by means of a simple manometer constructed of a quarter-inch U-shaped glass tube, half filled with water, and connected with one nostril. The effect of the breathing experiments was registered graphically by means of curves which are reproduced in Fig. 9. His study shows that in breathing through the nose, the positive pressure rose to +1, and the negative pressure fell to –3, while mouth-breathing produced barely one-quarter inch positive or negative nasal pressure. Leader concluded that this fluctuating air pressure stimulates the nasal mucosa. The effect may be compared with Bier's treatment

Fig. 10.—Boy, aged ten years, with ankylosis of the temporomandibular joint caused by childbirth trauma, showing underdevelopment of the mandible. Affected ear on other side. (Courtesy Harvard Dental School.)

to induce hyperemia; it increases the blood supply and fosters bone growth of the maxilla which contains the nasal cavity and accessory sinuses.

These findings fit into our picture in excellent fashion because we find underdevelopment of the maxilla in three anodontia cases which had nasal disturbances. In one of the three patients with saddle nose (Prof. Nager's case) it was definitely stated that the patient suffered from ozena, atrophic rhinitis with crust formation, and chronic purulent discharge. Therefore interference with normal nose breathing due to nasal obstruction or disease must have been a factor in the underdevelopment of the maxillary part of the face. This deduction is further substantiated by the fact that anodontic patients with normal noses developed a normal maxilla (Figs. 4, 5, and 6). Normal refers to the condition of the maxilla proper and not the alveolar process which of course remains undeveloped if no teeth are formed.

CASES OF EARLY TEMPOROMANDIBULAR ANKYLOSIS

In bony and complete fibrous ankylosis of the temporomandibular joint contracted during infancy and due to childbirth trauma, infection of the middle ear, fracture of the base of the skull or mastoiditis, we find resultant retrusion of the mandible. Due to disuse, the muscles are underdeveloped and there is no great muscular force applied to this bone. The beneficial effect of increased

Fig. 11.—Girl, aged seven years, showing underdevelopment of mandible due to early ankylosis of the jaw. (Courtesy of Children's Hospital, Boston.)

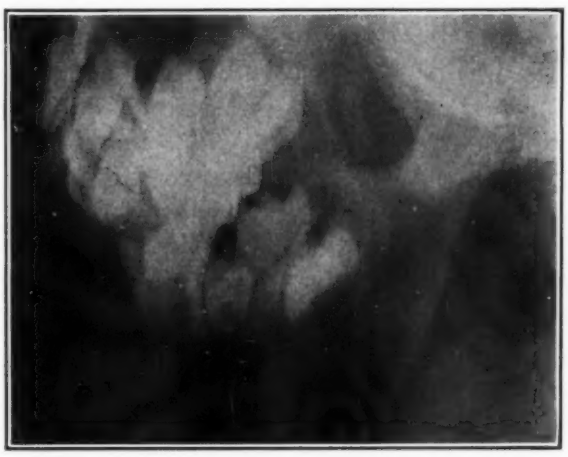

Fig. 12.—X-ray of girl shown in Fig. 11. The formation of the teeth has not prevented marked underdevelopment of the mandible, so that dentition is greatly interfered with.

collateral circulation in the bone associated with normal muscle function is lacking. As a result the mandible fails to develope to its normal size. A great many such cases have been reported. Two cases will serve as illustrations.

The first is a case of underdevelopment of the mandible due to childbirth trauma causing extensive laceration and loss of one ear. A photograph is shown in Fig. 10. In spite of the development of the teeth the mandible shows marked recession due to hypoplasia.

The second case (Fig. 11) is that of a girl aged seven years. She has been suffering from ankylosis of the jaw since she was eight months old. The teeth have developed, but the mandible has not. It is so small that even the first molar, partly erupted, has not sufficient room, and the second molar is forming in the center of the ramus, as seen in the roentgen film (Fig. 12).

In ankylosis therefore with function of the muscles of mastication absent due to their underdevelopment and the inability to move the jaw, the growth of the bone is markedly inhibited. As can be seen in the x-ray pictures this underdevelopment of the mandible, which may amount to as much as 40 per cent of the total length, occurs in spite of the formation and eruption of teeth.

The maxilla, however, is found to develop to normal size. This no doubt is due to increased nose breathing because patients with ankylosed jaws find it difficult to breathe through the mouth, and during strenuous physical exercise the air intake through the nose becomes exceedingly accelerated. How nose breathing stimulates the development of the maxilla has already been described. It explains why in ankylosis of the mandibular joint the maxilla develops in spite of the fact that the mandibular growth is greatly inhibited.

CONCLUSIONS

The mandible develops to normal facial proportions in anodontia when deciduous and permanent teeth are congenitally missing; it develops to normal size when the entire set of teeth is formed but remains unerupted and impacted, but it fails to develop and remains considerably undersized in cases of early acquired ankylosis with muscle function reduced to a minimum. The development of the mandible seems therefore to be influenced principally by muscular function, and its associated increase in collateral blood circulation, and because the most powerful muscles are attached to the ramus its growth occurs principally in the posterior part. This accounts for the common observation that in case of underdeveloped mandibles with the second molar close to the ascending ramus, preventing the eruption of the third molar, the space between the distal surface of the second molar and the anterior border of the ramus is not enlarged while the third molar develops. The growth occurs posterior to the third molar region.

The maxilla seems not to be dependent to any great extent on the function of the muscles of mastication for its development and growth, as it may be found developed to normal size in cases of early ankylosis of the temporomandibular articulation. The controlling growth factor for the maxilla therefore appears to be nose breathing through its effect on the pneumatic cavities, and the blood supply of the bone.

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GENERAL ANESTHESIA IN MAJOR DENTAL SURGERY

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SOME may ask just what does the term "major dental surgery" mean. The terms major and minor surgery are used in general surgery, and there as in dental surgery the line between the two is not clearly drawn. Putting a stitch in a small cut or lancing a boil is surgery; yet you cannot compare the skill and technique required for this minor work with the skill and technique required in a major operation such as a brain operation, removing a gallbladder or an appendix.

The surgeon does minor surgery as well as major surgery; most physicians may do some minor surgery, but rarely do they attempt the more serious operations or major surgery because they feel they are not qualified.

The same conditions apply to dental surgery; most dentists do some minor surgery, such as opening abscesses, simple extractions, etc., but the more serious cases or the major dental surgery is referred to the oral surgeon because the average dentist is not qualified or equipped to handle the major cases.

In this paper, when I speak of major dental surgery, I am referring to the removal of one to four impacted teeth, the removal of a large bone cyst, extracting a large number of teeth, trimming the alveolar process and suturing the gums; such cases require general anesthesia, hospital care, and nursing. Only the oral surgeon is qualified to take care of these cases in a dental or a general hospital.

Major dental surgery is comparable to a great deal of major general surgery and therefore is dependent on all the rigid technique and detail of general surgery for the best result. Many men in both the medical and the dental professions do not realize that if the best results are to be obtained in major dental surgery the most rigid operative technique must be adhered to. Many physicians and dentists seem to think the patient can walk into a dental office or hospital without any preparation (few think it necessary for the patient to go to a hospital) and have fifteen or twenty teeth extracted, one to four impacted teeth removed, or a large bone cyst removed; that the operator should have no trouble and the patient should leave in a few minutes, feeling no ill effects from a major operation.

The reason that most physicians know so little about major dental surgery is quite simple; they rarely if ever see a major dental operation. When they find their patient needs some dental work, they refer him to a dentist and that is all they know about it until the patient returns with the work completed.

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Many dentists who do no extracting are almost as bad as the physicians; they refer their patients to an oral surgeon and rarely take the trouble to see the operation. Still other dentists who do their own simple extractions seem to think the oral surgeon should have no more trouble with the major cases and that the patient should submit to a major operation and come out smiling. It is not unusual for an oral surgeon to have these patients walk in his office expecting to have their work done at once, and he is frequently criticized by physicians and dentists as well as the patients because they are requested to return at a later date with the proper preparation. Too much major dental surgery as well as general surgery is being done today without the proper preliminary study and preparation of the patient.

In twenty-four years of anesthesia work with various surgeons and dentists in a number of hospitals, I have seen many instances in which the surgeon or the dentist failed to make the proper preliminary study and preparation, and disregarded definite reasons why the patient should not be operated upon at that time, and the patient paid the penalty. I have seen infection, cellulitis abscess, and death following extraction of acutely infected or abscessed teeth.

I wish to mention two surgical cases that ended disastrously because the surgeon disregarded danger signals.

Case 1.—The anesthetic was about to be started on a ward patient, a small boy, for a tonsillectomy when I discovered that the child had an acute cold with a fever. I reported this to the surgeon and suggested that he wait until the patient was free of fever. He replied that the fever did not amount to anything and to go ahead. He operated and the hospital had a free patient on its hands for the next six months; the boy developed double mastoid, diphtheria, and everything possible except worms. Two or three days' delay would have saved all the trouble.

Case 2.—An adult private patient was to have a tonsillectomy; I noticed he had a fever and slight cough. Again I suggested postponing the operation, and again I was overruled. The patient developed a lung abscess and was ill for some months.

LOCAL ANESTHESIA

I know that some dentists use local anesthesia in practically all their work. Good local anesthesia is better than poor general anesthesia where the dental office does not have a good anesthetist available and is not equipped with an operating room, proper recovery room, and a nursing staff. Local anesthesia appeals to a great many patients because they do not have to go to sleep or become unconscious. Many patients fear they will not awaken from the anesthetic. Also many patients like to tell that they have had such and such an operation under local anesthesia and that they knew everything that was being done by the operator. Local anesthesia permits the operator to take his time; in fact he requires more time, he must be deliberate and careful to confine his work to the anesthetized area. Also he must not forget that he is dealing with a conscious patient, and the mental phase of the patient cannot be forgotten. Local anesthesia requires less equipment and is not so expensive as general anesthesia.

Some disadvantages of local anesthesia:

A. There is more shock. I have seen nervous patients months recovering after a number of teeth had been extracted under local anesthesia.
B. Healing of the wound is retarded, for there is traumatism from the injection of the local anesthetic agent in addition to traumatism from the operative work.
C. As a general thing the operative work is more limited under local anesthesia. Frequently several days are required to accomplish what could have been completed easily under general anesthesia at one operative period.
D. Infection is commoner after local anesthesia.
E. Some patients are hypersensitive to any local anesthetic agent.
F. Local anesthesia is not without danger per se.

Recently I called my office and was informed that Dr. B., a dentist, had telephoned several times and that I was to get in touch with him at once. When I called him, he was very much excited and stated that he had a patient in his office in a serious condition. I gathered from his remarks over the telephone that it was possibly a case of novocaine poisoning. At his office I found a woman, about thirty-five years of age, sitting in a dental chair cyanosed, dyspneic, lips, eyes and face swollen, face and body covered with hives. The pulse was rapid and weak; the heart was laboring badly so that the patient not only looked to be in danger but actually was in a serious condition. I immediately lowered her head and gave her 25 drops of adrenalin solution hypodermically. In about twenty minutes her breathing was somewhat better, and the swelling about the eyes and the lips seemed to be receding. She required several more doses of adrenalin solution before she was out of danger and could be moved to her home, and she was not entirely relieved of the hives for forty-eight hours. About three-fourths of a stock ampule of novocaine solution had been injected for the extraction of a tooth. This was a clear case of novocaine poisoning. Either she was hypersensitive to novocaine or it had been injected directly in a vein.

A physician injected a patient with novocaine for tonsillectomy, and in a few minutes the patient was dead. Believing the patient had been hypersensitive to the solution, he went ahead and injected a second patient, and within an hour the second patient was dead.

Whether both patients were hypersensitive to novocaine or whether something was wrong with the novocaine solution I cannot say, but I can say that two patients died and one almost died of the novocaine per se.

The various types of general anesthesia that may be used in major dental surgery are:

1. Nitrous oxide and oxygen.
2. Ethylene oxygen.
3. Ether.
4. Avertin and the various sequences or combinations.
5. Nitrous oxide, oxygen and ether sequence or nitrous oxide and ether combination.

6. Ethylene-oxygen-ether sequence or the combination of ethylene-oxygen and ether.
7. Ether anesthesia alone, starting with the open method for induction and changing to the vapor method for the surgical anesthesia.
8. Avertin anesthesia or avertin as a basal anesthetic to be followed by nitrous oxide and oxygen, ethylene-oxygen, ether or the combination of ether with nitrous oxide and oxygen or ethylene-oxygen.

Today it is the rule rather than the exception to use two or more anesthetics during one anesthesia. With the various combinations we afford the patient the greatest comfort and safety and at the same time give the dental surgeon the proper relaxation. The patient's mental and physical condition must be considered before, during, and after surgery and anesthesia.

NITROUS OXIDE AND OXYGEN ANESTHESIA

To produce the desired anesthesia for dental surgery one must have an apparatus that will at all times deliver to the patient an unlimited amount of the various gases, to which if needed ether vapor may be added to obtain the relaxation that gas anesthesia will not always produce. One must also have an anesthetist who understands using nitrous oxide and oxygen under pressure and giving it through the nose while the work is being done in the mouth. Many expert anesthetists give a poor dental anesthetic because of lack of experience, since they seldom are called for such work. With the proper apparatus and a well-trained anesthetist, all simple extractions and the greater part of major dental surgery can be handled under nitrous oxide and oxygen anesthesia. Major cases lasting from twenty minutes to an hour or more will tax the utmost skill of the anesthetist to maintain good relaxation at all times. It must be remembered that with the mouth packed off and the dental surgeon doing his work, anesthesia is interfered with quite frequently. The anesthetist must be able to maintain the proper anesthesia without continually interrupting the surgeon to remove the packs and let the patient have more oxygen or air. Major dental surgery under nitrous oxide and oxygen anesthesia requires perfect teamwork.

We must understand that nitrous oxide and oxygen anesthesia cannot be used for all patients if complete relaxation is desired throughout the entire operative period. Where nitrous oxide is pushed to the limit and there is cyanosis for some time, frequently there will be more bad effects than if some ether had been added for relaxation and to maintain a better color.

NITROUS OXIDE-OXYGEN-ETHER COMBINATION

A patient who fights under nitrous oxide and oxygen can be handled much better if ether is added. All modern gas apparatus have an ether attachment so that the patient is anesthetized with nitrous oxide and oxygen, and then ether is added as needed to maintain the desired relaxation during the operative period. Such anesthesia permits the dental surgeon to work quickly and at the same time do better work, because the patient is quiet and the dental surgeon is not worried that he must hurry through the operation because the patient is cyanosed

or struggling. The patient, the dental surgeon, and the anesthetist are all in better condition after this type of anesthesia.

NITROUS OXIDE-OXYGEN-ETHER SEQUENCE

This is used when you merely start anesthesia with nitrous oxide and oxygen and then change to ether anesthesia to avoid discomfort to the patient by starting with straight ether or when you know from the first or find during anesthesia that nitrous oxide and oxygen will not give the desired relaxation, and you have to change to some method of ether anesthesia.

ETHER ANESTHESIA

Today in the modern dental hospital which has a trained anesthetist on the staff and is equipped with gas apparatus, avertin, etc., straight ether anesthesia is rarely used. The patient's comfort and well-being are considered so much today that I might say you would be justified in using straight ether anesthesia only in an emergency. In considering major dental surgery, you expect anesthesia that gives good relaxation; therefore complete ether anesthesia is not desirable for office work. I might add, however, that with small children, when nitrous oxide and oxygen is not available, a great deal of dental work can be done under primary ether anesthesia. If only a small amount of ether is used, there will be very little if any nausea and the child will have to remain in the dental office only a short time.

ETHYLENE-OXYGEN ANESTHESIA

Ethylene-oxygen produces better anesthesia with more relaxation than nitrous oxide and oxygen but not so deep an anesthesia or the same degree of relaxation as can be obtained with ether. In other words, considering the same degree of surgical anesthesia and safety for the patient, ether is first, ethylene second, and nitrous oxide third.

In my work in general surgery, ethylene has replaced nitrous oxide in all cases except when the cautery is going to be used, or there is likely to be a spark from a motor, etc. In the x-ray room when the fluoroscope is to be used, both ethylene and ether are contraindicated.

In dental surgery ethylene-oxygen anesthesia has not found special favor, chiefly because of its explosiveness and its odor, and it causes more nausea than nitrous oxide and oxygen.

If used in dental surgery the same precautions must be taken against its explosiveness as in general surgery; that is, all flames, sparks, and motors must be kept out of the room. In dental surgery some think there is a possibility of a spark being caused by the forceps slipping off a dead tooth or a tooth that contains a metal filling, or while working on such a tooth with a chisel. It may be possible, but I have yet to encounter a spark in the mouth under the above conditions. As to the odor of ethylene, that is of little consequence today. When we first started using ethylene, the odor was offensive to those working in the operating room but not to the patient. Today the ethylene is much more refined, does not leave a deposit in the water bottle, and the operating room force do not complain of its odor, for there is little to complain about.

The patient rarely complains about the odor of ethylene; in fact there is not one in fifty who can describe the odor of ethylene after anesthesia. When asked the simple question, "What did it smell like?" they will usually reply, "Well, it smelled like—ah, let's see, I don't know, but it was not bad." I think the patient goes to sleep so quickly with ethylene that the real odor of ethylene does not have a chance to register on the olfactory nerves; hence the inability to describe the odor after anesthesia. From the first, the complaints about the odor of ethylene have always come from the operating room force rather than from the patient.

Nausea, like odor, has much decreased with the more refined ethylene of today. With my portable anesthesia apparatus, I now carry only ethylene and oxygen. Nausea is quite objectionable in office anesthesia; and, if nausea were resulting in the anesthetics I administer, it is quite certain that operators would not demand ethylene. They want ethylene-oxygen in preference to nitrous oxide and oxygen because there is much better relaxation. I have found that when ethylene-oxygen is used, if the patient is kept quiet and not permitted to talk for a few minutes nausea rarely results. When these patients talk immediately after ethylene anesthesia, they undoubtedly have more nausea. I cannot explain the reason.

In short operations, when the inhaler is removed, I place my hand or a towel over the patient's eyes and tell him to be quiet and not talk; nor do I permit the mothers to talk to their children. In the major cases the patient is sent back to his room; a moist towel is placed over his eyes; and he is instructed to keep quiet and not talk. The room is darkened, visitors are kept out, and the nurses understand they are to make no needless noise in the room.

I do not use morphine sulfate with ethylene-oxygen anesthesia; much of the nausea attributed to ethylene is due to premedication of morphine. Many do not seem to realize that morphine sulfate gr. ¼ will cause nausea in twelve to twenty-four hours in many patients.

I find there is no more nausea with ethylene-oxygen than with morphine sulfate and nitrous oxide and oxygen in the difficult cases. For in this type of case the nitrous oxide must be pushed to the limit to control the patient, and in major dental surgery with the mouth packed off there is usually more or less cyanosis, and with prolonged cyanosis usually there is nausea.

AVERTIN

Avertin was first tried for complete anesthesia, but it was found that the amount required to produce relaxation over a prolonged time depressed respiration to a dangerous point, and many deaths occurred during the experimental period. Then 150 to 200 mg. per kilobody weight was being used. Avertin is now used only as a basal anesthetic, and the amount now used is from 50 to 80 mg. per kilobody weight. These amounts are safe, they produce deep sleep and in some few cases enough anesthesia to do some minor work. They are not given with the intention of producing general anesthesia. When avertin is to be used, the patients are instructed to ascertain their weight the night before, stripped, take one or two soap and water enemas, as needed, to wash out the lower bowel completely, take a dial tablet or some similar hypnotic, go to bed early, get a

good night's sleep, and report the next morning without breakfast at least two hours before the time set for the operation. Morphine sulfate is not used with avertin before operation. The avertin is given thirty minutes before the operation so that the patient comes to the operating room in a profound sleep or under a light anesthesia. It is our custom to administer the avertin in the patient's room so that he has no knowledge of going to or returning from the operating room. Patients usually sleep one to three hours after the operation. I have had few patients react at once when the nitrous oxide and oxygen is stopped. Only light nitrous oxide and oxygen is now required to maintain complete relaxation as long as needed. The combination of avertin anesthesia and light nitrous oxide anesthesia produces about the most perfect anesthesia we have for major dental surgery. It gives the operator a quiet patient with complete relaxation and least interference from the anesthetist.

Another advantage of avertin and nitrous oxide and oxygen anesthesia is that it does not stimulate the secretion of saliva or mucus; so with the aspirator taking care of the bleeding, almost a dry operative field can be maintained.

The patient receiving avertin must be watched by a nurse before he goes to the operating room and until he has fully awakened. Avertin is not adaptable for office anesthesia and should be used only in a general hospital, a dental hospital or a dentist's office equipped with bedrooms, operating room and proper nursing staff. Two minor objections to avertin anesthesia are that it requires about forty-five minutes more of the anesthetist's time to prepare and have the solution given to the patient in advance of the operation and also the patient requires more attention from the nursing force before and after the operation. I insist that a nurse remain in the room for three hours with the patient after he has had avertin. These should not be considered objections for they are offset by the many advantages the patient gains from the avertin; after all, it is the patient who must be satisfied for he pays the bill in two ways: first, in discomfort and suffering and, second, at the cashier's desk.

I have yet to find a patient do anything but sing the praise of avertin, and once he has had avertin he always demands it for a second operation.

The use of avertin both in general surgery and in major dental surgery has reduced the use of ether to a minimum. Ethylene-oxygen and ether both can be used with avertin, but I have never needed ether with avertin and nitrous oxide and oxygen to obtain good relaxation for major dental surgery.

PREOPERATIVE PREPARATION AND PREMEDICATION

In dental surgery the proper preoperative preparation and premedication have a very important bearing on anesthesia and surgery during the operative period and the postoperative recovery of the patient. All patients are instructed that the night before operation they should have a light dinner, take a mild purgative, go to bed early, and in order to insure a good night's rest they are given a dial tablet or some similar hypnotic. They are instructed to report without breakfast at least two hours before the operation.

Recently a society girl was to have a major dental operation and she was quite nervous; in trying to get her to relax somewhat before I started the anesthetic, I asked if she had had a good night's sleep. She replied that she had

stayed up until 4 A.M. drinking high balls and smoking cigarettes. She had done this thinking she would be tired and sleepy the next day and would sleep the afternoon after the operation. Her anesthetic was difficult and her recovery was stormy.

I mention this case to show the importance of giving the patient preoperative instructions, and also to give you an insight on how little patients know about preparing themselves for an operation. We all know that the acutely intoxicated patient is anything but a desirable anesthesia patient; yet it is surprising how many dental patients will fortify themselves with alcohol if not properly instructed.

PREMEDICATION

Most patients who have had a dial tablet or some similar hypnotic the night before will be somewhat drowsy the next morning. If we are going to use nitrous oxide and oxygen, we usually repeat a dial or nembutal tablet two hours before the operation or give ¼ gr. morphine sulfate hypodermically one-half hour before the operation. Both have their advantages and disadvantages.

With the least resistant patient a barbiturate works very well, produces more sleep and less nausea, so that the patient passes most of the operative day sleeping.

Morphine sulfate acts better with the more difficult patient; it produces more relaxation, thus greatly aiding nitrous oxide and oxygen anesthesia. It also relieves postoperative pain for some time. The patient does not sleep so much as when a barbiturate is used, and there is likely to be more nausea.

With ethylene-oxygen and avertin no premedication is used except the hypnotic the night before the operation. I feel that all operative patients, regardless of the kind of anesthesia that is used, should have a hypnotic so that they obtain a good night's sleep.

Morphine sulfate gr. ¼ and atropine sulfate gr. $\frac{1}{150}$ are the best premedication for ether anesthesia; it reduces the amount of ether needed and retards the secretion of excess mucus.

CONCLUSIONS

1. Many dentists and physicians lack the proper knowledge as to what their patients should expect when they are sent to the dental surgeon.

2. Local anesthesia has many disadvantages.

3. I believe general anesthesia is better than local for major dental surgery.

4. There is a type of general anesthesia that will fit any operation for major dental surgery.

5. Avertin and nitrous oxide and oxygen is the most perfect anesthetic we have for major dental surgery.

6. Many patients up for major dental surgery are not given the best preoperative preparation and premedication.

1420 Rhode Island Ave. N. W.

SUPPURATION OF THE TEMPOROMANDIBULAR JOINT WITH FATAL OUTCOME

GEORGE W. CHRISTIANSEN, A.B., D.D.S., M.S., DETROIT, MICH.

MRS. S. B., aged seventy-eight years, was first seen June 15, 1937, complaining of pain and trismus in the left temporomandibular joint. Inspection showed an edematous area projecting about 2 cm. extraorally above the joint capsule. Digital examination accomplished by manipulating the mass between two fingers within the mouth and two on the face revealed a soft, fluidlike mass approximately 5 cm. in diameter. Temperature was 99° F.

A lateral jaw radiograph showed the condyle anterior to normal, and resistance was met in attempting to reestablish correct articulation. Leucocytosis was present; the white count was 12,000. Physical findings were otherwise normal, and the past history was negative. The patient was hospitalized.

Fig. 1.

Under regional anesthesia an incision was made just anterior to the external auditory meatus over the softest part of the swelling, and dull dissection extended to the region of the capsule. Only serous drainage was obtained, but rubber drains were inserted and the borders of the incision loosely approximated. Within forty-eight hours profuse suppuration developed, which proved to be staphylococcus and streptococcus; the local pain and trismus subsided, and the patient felt much improved. Drainage was provided for and continued, the lesion was gently irrigated frequently with germicidal solutions, and foreign protein was administered 1.5 c.c. intramuscularly each third day for five doses.

The patient continued to grow weaker, and died September 17, 1937; a postmortem examination was refused.

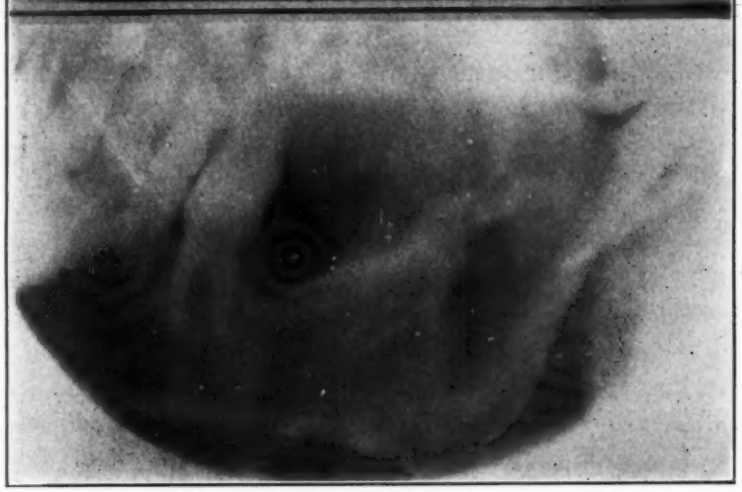
CYST

WILLIAM J. MCLAUGHLIN, D.D.S., BRIDGEPORT, CONN.

CYST of embryonic origin operated upon in 1935. Fig. 1 shows the cystic area. Fig. 2 shows the repair that has taken place in the bone.

Fig. 1.

Fig. 2.



The patient gave a history that some years previous he had had the second and third molars removed because of a swelling in the third molar region.

This is a good example of the repair that takes place in cystic cases.

Department of Orthodontic Abstracts and Reviews

Edited by

DR. EGON NEUSTADT, NEW YORK CITY

All communications concerning further information about abstracted material and the acceptance of articles or books for consideration in this department should be addressed to Dr. Egon Neustadt, 133 East Fifty-Eighth Street, New York City.

Periodontal Disease (Paradentose). By Dr. med. and dent. Walter Staerke, 1937, J. F. Lehmanns Verlag, Munich.

Periodontal disease, according to the author, is never the result of a single disturbance but of the combined action of several disorders. Furthermore it is not *one* disease but the symptomatic expression of a large number of pathologic conditions within the organism. It is the peculiar reaction of the mucous membrane of the mouth and of the gingiva to show to a marked degree the signs of infectious diseases and of other disturbances of a general nature. Periodontal diagnosis consists of three distinct parts: (1) anatomic findings, (2) functional considerations, and (3) internal components. In a like manner, therapy consists of (1) local treatment, (2) occlusal balancing, and (3) general medical care.

In a consideration of internal components it becomes difficult to determine what is normal and what is abnormal. As long as the masticatory apparatus is able to perform its functional requirements, a biologic equilibrium is present. The genetic structure of the various tissues, however, is different in each person; there exists a highly efficient tissue which shows great perfection in anatomic and functional regards and which is resistant to injuries; there is another tissue less perfect and less resistant.

Then we must consider the process of ageing, which influences also the most resistant tissues and which renders the less perfect prematurely senile. To these constitutional factors comes the influence of human domestication as a result of our having left our original natural environments and submitting to new, artificial stimulations. It is one of the characteristics of domestication that the organs do not retain the same degree of resistance which they possessed under original conditions. In man, the process of domestication effected a rearrangement of the head, noticeable by a larger development of the brain case and a simultaneous diminution of the facial portion. These regressive changes brought about a still lower resistance of the mouth and its organs, and especially its vasomotor system.

Besides the blood vessels, there belong to the internal component: the *vegetative nervous system,* sympathicus and parasympathicus, which control the tone of the whole alimentary canal and which affect the periodontium through the increased or decreased tone of the muscles of mastication, through vagotony, and vasomotor disorders; the *hormones,* which govern the intermediate cell

metabolism and are responsible for certain functional stimulations; of special importance for periodontal disease are secretions of the thyroid, hypophysis, and the sex hormones; the *connective tissue*, which is the carrier of inherited constitutional factors and which probably determines whether periodontal reaction manifests itself in destructive or in inflammatory changes; the *electrolytes* (chlorin, sulphuric acid, phosphoric acid, carbonic acid, as anions; natrium, potassium, calcium, magnesium as kations) which regulate the osmotic pressure within the cells and the acid-alkaline balance of blood and lymph; *nutrition*, which influences the colloidal equilibrium of the periodontal tissues and which may also produce anaphylactic reactions; *vitamins*, and calcium metabolism which plays an important rôle in all destructive forms of periodontal disease.

Anatomically, the periodontium must be considered as a syndesmosis, a true articulation between tooth and alveolar bone, with all the qualities of an articulation, including increased vulnerability to dystrophic and inflammatory processes. The blood vessel and lymph system which is distributed throughout the periodontium gives it the character of a hydraulic system. This system reinforces the peridental fibers in supporting the masticatory pressure.

In a general way, etiologic factors of periodontal disease can be divided into two groups: those of inflammatory character (infections, mercury poisoning, hormonal influences, lack of vitamins, disturbances of local metabolism; neurotrophic changes, psychogenic disorders, allergic irritations) and those of non-inflammatory origin (traumatic occlusion).

Anatomically, there are the following types noticeable: (1) senile and pre-senile atrophy (horizontal atrophy); (2) inflammations; (3) allergic arthritic diathesis (gout, adiposis, diabetes, eczema, bronchial asthma, colitis, rheumatism, ulcus ventriculi and duodeni, arteriosclerosis and hypertony); (4) vegetative disturbances (hypertonic-spastic type); (5) wander-paradentosis (characterized by a spontaneous movement of teeth).

The treatment of periodontal diseases consists of: (A) medication; (B) instrumentation; (C) gingivectomy; (D) stabilization through ligatures or permanent splints; (E) toothbrush massage; (F) thermal and chemical stimulation; (G) devitalization (which acts through a rearrangement of blood and lymph supply, halts further progress of paradental diseases and tends to make loose teeth firm); (H) besides these local therapies, it is necessary to institute a causal treatment in accordance with etiologic factors present (hormone therapy, vitamins, regulation of metabolism, balancing of vegetative nervous system in vagatony or sympaticotony, etc.); (I) diet; (J) homeopathy.

Traumatic Occlusion and Occlusal Balance. Traumatic occlusion is present if the force of mastication is not equalized by the strength of the suspensory apparatus of the peridental membrane. The main objective in establishing occlusal balance is to decrease or to change the occlusal pressure in such a manner that it is rendered harmless. This is accomplished (a) by an even distribution of the occlusal pressure over all teeth present, (b) by a favorable relationship of clinical crown to clinical root (1:2), (c) by a parallel arrangement of the axis of opposing teeth. If such objectives cannot be accomplished by grinding and reshaping of the occlusal surfaces, the use of splints and in-

lays is indicated. The principles of occlusal balance must be extended into the construction of splints, bridges and partial plates.

As one of the more important books on periodontal diseases, Dr. Staerke's "Paradentose" affords an insight in the ideas of our European colleagues on the subject. The great stress which is placed on the internal components in the etiology demonstrates the importance given to considerations of general and systemic factors which, to an extent, is explained by the medical training which many European dentists receive. This chapter is written in a masterly fashion and gives an excellent conception of the many ramifications and connections which the subject bears to the general body make-up.

Disappointing is the chapter dealing with the wander-paradentosis, one group of which is supposedly characterized by movement of teeth due to resorptive and depository changes in alveolus and cementum (apparently without cause). Some vague theories of this nature have been advanced before (Gottlieb's diffuse atrophy), but have never been sufficiently defined either clinically or etiologically. Furthermore, regardless of such changes occurring in the alveolar bone, teeth would not move unless one or more of the forces of occlusion were disturbed at the same time. If these forces are in equilibrium, no movement can take place. If movement (wandering) does take place, it should be determined which of the forces of occlusion have been disturbed. In most instances it will be found that either changes in muscle habits or traumatic occlusion can be called upon to explain the movement. That such is the case is further evidenced by the author's own statement that so far, internal medication has not produced results in such cases, but that balancing the occlusion in conjunction with splints is the treatment method *par excellence*. Another statement to which I should like to take exception is the devitalization of teeth for the purpose of healing periodontal disturbances. The value of this procedure is not sufficiently proved to warrant its recommendation. Clinical reports have so far not been encouraging, and a scientific explanation is altogether lacking.

The text is well divided; its clever arrangement is made more effective by the use of three different types of print with varying spacing and boldness. Illustrations and diagrams are excellent.

Egon Neustadt.

The Intraoral Roentgenogram. By Professor Dr. Wolfgang Praeger, 1936, J. F. Lehmanns Verlag, Munich, Germany.

The intraoral roentgenograms which are discussed in this book were sent to the author by dentists at the time he was editing a column on Roentgendiagnosis in the dental journal "Deutsche Zahnaertztliche Wochenschrift." This explains the practical aspect of the publication, which does not endeavor to go into the theory or science of radiography.

The placement, the exposure, and the development of the intraoral film are treated in a few short chapters, and the interpretation of the completed roentgenogram takes up the balance of the booklet. The terms radiolucency and radiopacity are replaced by the simpler designations: transparency (light area) and opacity (dark area).

Transparencies in (1) the *tooth crown* are produced by: diminished calcification; hypoplasia; caries; loss of enamel through grinding or occlusal wear; cavity preparation; or fracture. Opacities of the tooth crown are seen in: formation of secondary dentin; foreign bodies.

2. The *tooth root* shows the following transparencies: perforations; fracture lines (should not be confused with the normally transparent neck of the tooth); root caries; root resections; root absorptions; internal pulp granuloma. Opacities: root canal filling and other foreign bodies (some root canal fillings are not very opaque and may simulate a living pulp); triangular superimposition of normal roots on multirooted teeth; hypercementosis; salivary calculus.

3. *Alveolar Process:* A. Transparencies: Sinus extensions; transparent areas around developing tooth crowns and roots (where the soft developmental tissues are still present); the apical granuloma; cysts (if the Roentgen ray has to travel through heavy bone, the outline of the cyst will not be sharp even if the cyst membrane is anatomically well defined). B. Opacities of the Alveolar Process: Lamina dura; impacted teeth; root rests; osteosclerosis (they are bone condensations which are dense but not well defined).

4. *Jaw bones* proper. A. Transparencies: The maxillary sinus which is of varying size. It lies in close proximity to the roots of the second molar in 45 per cent, first molar in 30.4 per cent, third molar in 27.2 per cent, second premolars in 19.7 per cent, canines in 5.3 per cent, and first premolar in 3.0 per cent. The outline of the sinus is always sharp; mandibular, mental, and incisive canals; osteomyelitis (not sharply outlined); osteitis tuberculosa; gumma; tumors; cysts.

Opacities of the jaw bones proper: Floor and septa of the antrum; floor of the nose; nasal septum; palatal line; mental spine; odontomas; callous formations due to healed fractures.

The division of all phenomena into opacities and translucencies adds a great deal to the simplicity of the presentation of the subject. It also helps overcome the lack of a systematic arrangement such as larger textbooks can supply. At the same time, a great number of unusual conditions are included in this volume which are not to be found in regular textbooks. All in all, this is a most unique and instructive presentation. The reproduction of the Roentgen films is extremely well done.

Egon Neustadt.

Editorials

Wind and Wind Instruments

IT IS not unusual for this JOURNAL to receive inquiries both from laymen and from members of the dental profession concerning the merits of the therapeutic use of wind instruments for the correction of malocclusion. Undoubtedly these inquiries result from the wide publicity which has been given this so-called method of orthodontic treatment which has appeared in lay magazines of national circulation. The subject has been favorably reported in the professional journal *Trained Nurse and Hospital Review,* in the lay magazine *Physical Culture,* and others.

Orthodontists for the most part are familiar with the history and background of the wind instrument gesture, and naturally are amazed that a scientific and meritorious work could be so crudely exploited in various publications.

They are familiar with the work done by the late Dr. Richard Summa upon this subject, and they know that Dr. Summa established some basis for the merits of the use of wind instruments as a supplement to orthodontic treatment. The whole idea, it is generally understood, in fundamentals and principle, is not far removed from the muscular training advanced and promulgated by Rogers and others. Orthodontists of wide experience know that the daily use of a wind instrument sometimes enhances muscular tone and power not only of certain facial muscles but also of the muscles of mastication, and such exercises can be an aid to orthodontic treatment when muscular training is needed to assist in procuring a result; just how much of an aid it can or may be is still speculative.

In Class II, Division 1, in very young children, in cases in which the complete functioning of the upper lip has been lost as a result of disuse and the lip has become atrophied and turns back from the maxillary anterior teeth, the act of blowing a wind instrument (if nothing more than a Boy Scout bugle) will assist in establishing the full use of the upper lip; however the bugle blowing is of no avail whatsoever if the maxillary anterior teeth are allowed to continue to protrude, because in relaxation the patient is unable to hold the lips in contact.

Some months ago an article entitled "Therapeutic Use of Wind Instruments for the Correction of Orthodontic Conditions" appeared in the *Trained Nurse and Hospital Review.* The editor of the AMERICAN JOURNAL OF ORTHODONTICS AND ORAL SURGERY, being at a loss to know why an article of no more scientific basis and so entirely misleading in thought could appear in a profes-

sional journal, wrote to the editor of the *Trained Nurse and Hospital Review* to inquire why such an article prepared by a layman and containing only a fringe of truth should be published. Excerpts from the reply to this inquiry follow:

"Perhaps I would not feel this so keenly if I had not been subjected to the early straightening processes that prevailed around 1908-1910. I am one of those unfortunates who inherit the tendency to cut the right canine tooth late. When mine did not descend, a brace was applied to accomplish the feat by traction. As my molars were close, they were filed to permit the application of the brace. I wore them for two years with weekly adjustments. Where these teeth were filed I now have fillings; also where these braces articulated with the teeth of the lower jaw I also have fillings. Otherwise I have not a decayed tooth in my mouth. The tooth was finally coaxed down for part of the distance, but the root had been subjected to such pressure that it was almost entirely absorbed in the process, and when my child was born the tooth left me entirely. I now possess a pivot tooth held in place by the teeth at either side. This is about ten times as sightly as the half descended fang with which I had to live from eighteen to twenty-eight, and had this been inserted in the beginning I would have been saved the ruination of these molars as the result of the abrasions of the apparatus. The straightening was done by one of the leading orthodontists in —— at that period. Naturally the public which has had some of these experiences is ready to grasp at anything which will prevent a repetition.

"If this idea has certain sound principles in it, they should be tried out under experienced orthodontists with other intervention undertaken as and when needed."

There is only one logical conclusion to be drawn from the above quotation—that the editor of the above mentioned journal nurses a grudge and does not differentiate between the merits of orthodontic practice of twenty-five years ago and that of today, which is comparable to the difference between the model T Ford and the 1938 model. There is obviously also some solace to be gained in an open barrage on the entire orthodontic field.

Orthodontists should collectively and individually protest careless publicity. They should write to editors who give space to such articles, particularly when the article is prepared by laymen who (putting it charitably) know not whereof they speak. To be less charitable, however, and justly so, there have appeared in lay magazines photographs of models and photographs of patients "before and after" treatment, who have ostensibly been treated by an orthodontist, but these are displayed in such a manner as to give the impression that the case was corrected through the use of the "wind" method. This type of publicity is a gross injustice to the memory of Dr. Summa, a pioneer orthodontist; it is also a travesty on orthodontic practice. In its present state of evolution all that is lacking in the "wind treatment" is the traditional antecedent "bag of," preceding these articles prepared for lay reading, on the subject of orthodontics.

It is another case of a little knowledge being a dangerous thing, and orthodontists should make it a point to protest the clowning of their work, which occurs when articles appear that are excellent and nothing is wrong with them except that they are not true.

—*H. C. P.*

Casto Goes to California

Frank Casto, M.D., D.D.S., has recently moved from Cleveland, Ohio, and is settled for the practice of orthodontics in La Jolla, California. This move will interest orthodontists, particularly, for a number of reasons: first, because Dr. Casto is a past president of the American Dental Association, a past president of the American Society of Orthodontists, and for many years he was dean of the School of Dentistry of Western Reserve University, and this year is president of the American Board of Orthodontia; second, because he has been one of the constructive and outstanding leaders not only of orthodontics but also of dentistry for many years; third, because Dr. Casto, after many years of successful practice, and his son, Bill, decided to present themselves for examination before the California State Board of Dental Examiners, father and son at the same time. Dr. Casto also passed the Board of Examiners of the California Medical Association. The fact that he passed these two examinations within a few months is rather unusual.

The good wishes of a host of friends, admirers, and former students go with Dr. Casto and his son to their new location in La Jolla.

When the trek starts in July to the annual meeting of the newly formed American Association of Orthodontists, Frank Casto will again be there, but this time he will greet you as a full-fledged, sun-kissed Californian, and not as a citizen of the Great Lakes region, as he has been known for these many years.

The honors Dr. Casto has deservedly received from the dental profession, and particularly as an orthodontist, are legion; and it is to be hoped that he has gone to California not to retire, but only for new inspiration and new responsibilities.

H. C. P.

In Memoriam

Henry Clay Ferris
1870-1937

DR. HENRY CLAY FERRIS, one of the first orthodontists, honorary vice president of the First International Orthodontic Congress in Paris in 1914, died of heart disease November 10, 1937, at his home in Garden City, Long Island, New York.

Henry Clay Ferris was born in Brooklyn, New York, December 3, 1870. He attended Bordentown Military Institute, Bordentown, New Jersey, and in 1892 was graduated from the Dental School of New York University. In 1906 he was graduated from the Edward H. Angle Post-Graduate School of Orthodontia in St. Louis, and for many years devoted his practice exclusively to the specialty of orthodontics in New York City.

Dr. Ferris was a civic leader in his home community of Garden City. He was one of the original founders of the village, was a member of the village planning committee, and a member of the board of vestry of the Cathedral of the Incarnation, Garden City. He belonged to the New York Academy of Science, was a life member of Delta Sigma Delta, a member of the Union League Club, the New York Commandery of the Loyal Legion of Honor, and the Honorary Postgraduate Fraternity of New York University. He was also a past president of the New York Society of Orthodontists.

Dr. Ferris was an outstanding individual, a brilliant student with a keen scientific mind, and a constant seeker of truth in all his professional career. Those who knew him best will remember him primarily as a student, an outstanding personality, and a man of unusually keen intellect. The specialty of orthodontics has lost one of its foremost workers. Another one of the pioneer orthodontists who helped to make history at the birth of the specialty has passed on. His death closes the chapter of the life of a man who made his profession much more than a means of livelihood. The loss of H. Clay Ferris, as he was familiarly known, will be keenly felt by his many colleagues throughout the world. It can be truly said of him that he was a gentleman, a student, and a scholar.

Frederick Paine Wells
1874-1937

FREDERICK PAINE WELLS was born at Fairfield, Iowa, May 22, 1874, and died at Colorado Springs, Colorado, June 20, 1937. He was graduated from the University of Iowa College of Dentistry in 1895. He practiced dentistry at Clarinda, Iowa, until 1909 when he moved to Colorado Springs, where he remained until his death. He was graduated from the International School of

Orthodontia in 1914, after which he practiced orthodontia until his retirement in September, 1933. He was one of the pioneers in orthodontia in the Rocky Mountain region and an ardent supporter of organized dentistry.

He was a past president of the Colorado Springs Dental Society, the Colorado State Dental Society, and the Rocky Mountain Society of Orthodontists. He served two terms on the Colorado State Board of Dental Examiners. He was a member of Delta Sigma Delta.

In addition to organized dentistry, Dr. Wells, was also interested in local community affairs. He was a member of the Chamber of Commerce, of the Rotary Club, a Mason and a Shriner. His congenial nature won for him many lasting friendships.

Dr. Wells is survived by his widow, Hallie B., and two children, Dr. Warren Wells of Seattle, Washington, and Mrs. F. Marion Smith of Petersburg, Alaska.

News and Notes

American Association of Orthodontists

The thirty-sixth annual meeting of the American Association of Orthodontists will be held in Los Angeles July 11 to 14. This meeting will be held at the Roosevelt Hotel, which is located within the glamorous center of Hollywood, with its many interests for visitors from other states.

Dr. James D. McCoy, President
3839 Wilshire Blvd.
Los Angeles, Calif.
Dr. Claude R. Wood, Sec'y-Treas.
608 Medical Arts Bldg.
Knoxville, Tenn.

Southern Society of Orthodontists

The sixteenth annual meeting of the Southern Society of Orthodontists will be held at the Hotel Cleveland, Spartanburg, South Carolina, on February 7 and 8, 1938. All ethical members of the dental and medical professions are cordially invited.

Clyde O. Wells, President,
828 Montgomery Building,
Spartanburg, S. C.

William P. Wood, Jr., Secretary,
442 W. Lafayette Street,
Tampa, Florida.

International College of Dentists

The next annual meeting of the International College of Dentists, United States Section, will be held at the Stevens Hotel in Chicago, February 13, 1938.

Dr. Elmer S. Best, Registrar
801 Medical Arts Bldg.
Minneapolis, Minn.

Thos. P. Hinman Midwinter Clinic

The twenty-fourth annual session of the Thos. P. Hinman Midwinter Clinic will be held at the Biltmore Hotel, Atlanta, Ga., March 14 and 15, 1938.

Southwestern Society of Orthodontists

The eighteenth annual meeting of the Southwestern Society of Orthodontists will be held at the Adolphus Hotel, Dallas, Texas, March 6-9.

Dr. Oren A. Oliver and Dr. Hermann T. Becks will be the leading essayists.

All members of the American Association of Orthodontists are cordially invited to attend.

DR. HARRY H. SORRELS, Secretary
Medical Arts Building
Oklahoma City, Okla.

Five State Post Graduate Clinic

The District of Columbia Dental Society will conduct the Five State Post Graduate Clinic on March 6-9 at the Mayflower Hotel, Washington, D. C. This year the Committee has arranged a scientific clinic to conform to the principles on "Dental Health for American Youth" advanced by the president of the American Dental Association.

The following men will present papers: Dr. Malcolm W. Carr of New York; Dr. Oscar V. Batson, Graduate School of Medicine, University of Pennsylvania; Dr. Albert J. Irving of New York; Dr. Lon Morray of Chicago; Dr. Alexander H. Patterson, Professor of Prosthetic Dentistry, University of Maryland.

The afternoon of March 7, a reception will be held from 5 to 7 o'clock in honor of Dr. C. Willard Camalier, president of the American Dental Association.

DR. JOHN P. BURKE, President
Colorado Building
Washington, D. C.

Dental Society of State of New York

The seventieth annual meeting of the Society will take place May 10-13 at the Hotel Syracuse, Syracuse, New York.

DR. EDWIN I. HARRINGTON, President
Woolworth Building
Watertown, N. Y.

North Carolina Dental Society

The sixty-fourth annual meeting of the North Carolina Dental Society will be held at the Robert E. Lee Hotel in Winston-Salem, N. C., May 2-4, 1938. All members of the American Dental Association are cordially invited to attend.

FRANK O. ALFORD, Sec.-Treas.,
1109 First National Bank Bldg.,
Charlotte, N. C.

Mexican Association of Orthodontics

The first Medicodental Convention of the Mexican Association of Orthodontics will be held in Mexico City February 14-20. The object of the meeting is to gather together physicians, surgeons, dental surgeons, and orthodontists, both national and foreign, in order to derive from the resulting interchange of ideas the greatest possible benefits for the advancement of the respective specialties.

During the convention there will be lectures, surgical operations, clinical demonstrations, exhibitions, and moving pictures, by prominent members of the various branches of medicine and dentistry.

A delegation of American specialists will lecture on cancer, otorhinolaryngology, plastic surgery, orthodontics, pyorrhea, prosthesis, endocrinology, and pediatrics.

The following orthodontists will attend the meeting: Spencer R. Atkinson, George W. Hahn, Glen Terwilliger, J. A. Linn, B. Holly Broadbent, George Grover, and George Chuck.

Dr. S. Fastlicht, Secretary
Madero 40, Desp. 102
Mexico, D. F.

Cleveland Dental Society

The Seventh Annual Two-Day Clinic Meeting of the Cleveland Dental Society will be held April 4 and 5 at the Statler Hotel, Cleveland, Ohio.

Dr. John I. Sloan, General Chairman,
Rose Building,
Cleveland, Ohio.

Pacific Coast Society of Orthodontists

Northern Section

The regular meeting of the Northern Section was held at the Washington Athletic Club, Seattle, Washington, November 20, 1937.

Newly elected officers for the ensuing year are: Dr. Donald MacEwan, chairman, and Dr. Paul Lewis, secretary.

Dr. Donald MacEwan read a paper on diagnosis and treatment with the technique of the universal appliance, after which Doctors Rawlings, Casey, Mann, and MacEwan gave table clinics on its construction and application.

Central Section

The regular meeting of the Central Section was held at the Plaza Hotel, San Francisco, September 15, 1937. Dr. Herman Becks of the University of California and the Hooper Research Foundation presented a paper.

Southern Section

The regular meeting of the Southern Section was held at the University Club, Los Angeles, September 10, 1937. Dr. Frank Heimlick read a paper entitled "Endocrinology for the Orthodontist," and with the aid of charts briefly surveyed the locations of the ductless glands. Dr. Hays Nance brought to the attention of the members the surprising frequency and the difficult correction of the mesial drifting of mandibular posterior teeth.

Notes of Interest

Dr. Frank E. Shelden and Dr. F. Copeland Shelden announce the removal of their offices from the Professional Building and 6243 Brookside Road to the Plaza Medical Building, 315 Alameda Road, Country Club Plaza, Kansas City, Mo. Practice limited to orthodontia.

Dr. J. Camp Dean announces the removal of his offices to Suite 603 Franklin Building, 1624 Franklin Street, Oakland, California. Practice limited to orthodontia.